ILLINOIS NATURAL HISTORY SURVEY
PRAIRIE RESEARCH INSTITUTE

A Survey of Sport Fishing in the Illinois Portion of Lake Michigan

March through September 2015

Roswell, Charles R.; Czesny, Sergiusz J.

INHS Technical Report 2016 (46)

Prepared for Illinois Department of Natural Resources, Division of Fisheries

Issue Date: 11/30/2016

Sponsor: Division of Fisheries, Illinois Department of Natural Resources Grant/Contract No: Federal Aid Project F-52 R-30

University of Illinois at Urbana Champaign
Prairie Research Institute
Mark R. Ryan, Executive Director

Illinois Natural History Survey
Leellen Solter, Interim Director
1816 South Oak Street
Champaign, IL 61820
217-333-6880

INHS 2016 (46)

A SURVEY OF SPORT FISHING IN THE ILLINOIS PORTION OF LAKE MICHIGAN

March through September, 2015

Charles R. Roswell and Sergiusz J. Czesny

University of Illinois
Prairie Research Institute
Illinois Natural History Survey

Submitted to
Division of Fisheries, Illinois Department of Natural Resources
Federal Aid Project F-52-30

Sergiusz J. Czesny Principal Investigator	Geoffrey A. Levin, Acting Director Illinois Natural History Survey

This study is conducted under a memorandum of understanding between the Illinois Department of Natural Resources and the Board of Trustees of the University of Illinois. The actual research is performed by the Illinois Natural History Survey, Prairie Research Institute. The project is supported through the Federal Aid in Sport Fish Restoration by the U.S. Fish and Wildlife Service, the Illinois Department of Natural Resources and the Illinois Natural History Survey. The form, content, and data interpretations are the responsibility of the Illinois Natural History Survey and the University of Illinois and not the Illinois Department of Natural Resources.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Table 1. Common and scientific names of fishes appearing in this report of the survey of sport fishing in the Illinois portion of Lake Michigan. Only common names will be used in the following text.

Common Name	Scientific Name
Alewife	*Alosa pseudoharengus*
Bluegill sunfish	*Lepomis macrochirus*
Brown trout	*Salmo trutta*
Channel catfish	*Ictalurus punctatus*
Chinook salmon	*Oncorhynchus tshawytscha*
Coho salmon	*Oncorhynchus kisutch*
Common carp	*Cyprinus carpio*
Freshwater drum	*Aplodinotus grunniens*
Lake trout	*Salvelinus namaycush*
Largemouth bass	*Micropterus salmoides*
Rainbow smelt	*Osmerus mordax*
Rainbow trout	*Oncorhynchus mykiss*
Rock bass	*Ambloplites rupestris*
Round goby	*Neogobius melanostomus*
Sea lamprey	*Petromyzon marinus*
Smallmouth bass	*Micropterus dolomieu*
Yellow perch	*Perca flavescens*

EXECUTIVE SUMMARY

The purpose of this study was to estimate sport fishing effort, harvest, and expenditures by anglers fishing the Illinois portion of Lake Michigan (excluding charter fishing). Information provided by this study is important for management of sport fisheries in the Illinois waters of Lake Michigan. Data were collected via a contact creel survey on randomly-selected days over a six month period (4/1 - 9/30), and were summarized and extrapolated over the six month period to obtain estimates for specific locations as well as for the entire Illinois portion of Lake Michigan. Sampling dates were randomly chosen for access sites within two strata: time period (segment = three week blocks) and type of day (weekday vs. weekend/holiday). An additional March survey was conducted at selected sites along the Lake Michigan shoreline. The March survey was stratified by weekend/ weekday, but the entire month of March was treated as one segment. An additional winter survey of yellow perch fishing occurred during October 2014-February 2015. All data have been summarized by month for this report.

Conclusions:

1. Total angler effort in 2015 declined 11.6% from the 2014 survey period. Effort increased 2.5% for boat anglers and decreased 25.8% for pedestrian anglers.

2. The yellow perch harvest decreased 84.8% from 2014 estimates to 8,289 fish. Mean length decreased 3.6% to 25.9 cm (10.2 in), while mean weight decreased 16.7% to 222 g (0.49 lb.).

3. Coho salmon comprised most of the salmonid harvest (70.2%) and harvest increased 15.0% compared to 2014. The estimated 2015 coho salmon harvest was 34,856 fish. The mean size of coho salmon measured by creel clerks in 2015 was 1,007 g (2.22 lb.), and 47.2 cm (18.6 in) long, representing decreases of 12.2% in weight and 2.7% in length from 2014.

4. Chinook salmon harvest was estimated at 7,556 fish, a 50.8% increase from 2014. The mean size of Chinook in 2015 was 4,468 g (9.85 lb., an increase of 5.0%) and 72.4 cm (28.5 in) long (a decrease of 0.3% from 2014).

5. Compared to 2014, rainbow trout harvest decreased 51.1% to 3,342 fish. Mean rainbow trout weight decreased 13.0% to 2356 g (5.19 lb.), while length increased 0.6% to 62.5 cm (24.6 in).

6. The lake trout harvest decreased to an estimated 2,418 fish, a 43.7% decrease from 2014. The mean length of lake trout harvested increased compared to 2014 by 0.6% to 67.0 cm (26.4 in), and mean weight increased 7.3% to 3,056 g (6.74 lb.).

7. The estimated brown trout harvest decreased 76.2% from 2014 to 1,448 fish. Mean length of harvested brown trout decreased by 10.7% to 50.1 cm (19.7 in), and mean weight decreased by 35.7% to 1,715 g (3.78 lb.).

8. Estimates of total expenditures for boats, motors, trailers and fishing gear in 2015 were $4.26 million, 41.4% lower than in 2014.

9. In March, 2015, angler effort and harvest of brown trout, increased compared to 2014, while rainbow trout and coho salmon harvest decreased slightly. Total effort was 7,684 angler hours, rising 19.9% from 2014. March harvest in 2015 decreased 100% for rainbow trout (0 fish compared to 15 fish in March, 2014) and 5.4% for coho salmon (1,295 fish), and increased 1068.5% for brown trout (853 fish). As in March of 2014, no yellow perch, lake trout, or Chinook salmon harvest was documented in March of 2015.

10. In the winter (October 2014-February 2015), 11,610 angler hours were directed at yellow perch. Estimated harvest of yellow perch was 6,431, representing 10.6% of the March 2014-Feburary 2015 yellow perch harvest.

ABSTRACT

A contact creel survey was conducted from April 1 to September 30, 2015, covering all legal sport fishing during that period (both by pedestrians and anglers fishing from boats), excluding fishing from chartered boats and smelt fishing. The intent of the survey was to provide reliable estimates of sport fishing activity, sport fish harvest, expenditures for sport fishing, and the quality and distribution of sport fishing for the Illinois portion of Lake Michigan. Total fishing effort for pedestrians and boaters for the survey period was estimated at 320,963 angler-hours. Total harvest estimates for major species during the survey period include 8,289 yellow perch, 1,448 brown trout, 3,342 rainbow trout, 2,418 lake trout, 34,856 coho salmon, and 7,556 Chinook salmon. Angler expenditures for boats, motors, trailers and fishing gear were estimated at $4.26 million. Anglers traveled an estimated 2.45 million miles (round trip). The yield value of fish harvested by sport fishing was approximately $1.37 million.

An additional early-season survey was conducted during March 1 to March 31 at Waukegan Harbor, Montrose Harbor, and Calumet Park for pedestrian anglers and Waukegan Harbor and Calumet Park for launched-boat anglers. In total, anglers harvested an estimated 853 brown trout and 1,295 coho salmon in an estimated total of 7,684 hours of fishing during March. Total expenditures for fishing gear during March were estimated at $17,217.

An additional survey of yellow perch angling was conducted during October 2014-February 2015 at a variety of sites in Chicago. Yellow perch anglers harvested an estimated 6,431 yellow perch in an estimated 11,610 hours of angling in this fall and winter period.

INTRODUCTION

This report summarizes results of a survey of sport fishing in the Illinois portion of Lake Michigan from April 1 to September 30, 2015. All types of legal sport fishing during that period, with the exceptions of charter-boat fishing and smelt fishing, were covered by the survey. Two supplemental surveys were completed. First, a survey of the early spring fishery was conducted from March 1 to March 31. Second, a survey of "winter" perch angling was carried out during October 2014-February 2015 (see Appendix B). The intent of the project was to provide estimates of sport fishing effort, harvest, and quality, as well as estimated fishing-related expenditures for anglers fishing Illinois waters of Lake Michigan. Biological data concerning length, weight, sea lamprey wounding and scarring, and marks (fin clips and external tags) were also collected from angler-harvested fish. Creel surveys for the Illinois portion of Lake Michigan have been conducted annually by the Illinois Natural History Survey since 1985; results from the first thirty years of these surveys have been reported in annual technical reports, most recently for the 2014 survey (Roswell and Czesny 2015). Prior to these annual surveys, the most recent creel survey of this type in Illinois was conducted in 1979 by the Illinois Department of Conservation (Muench 1981).

Geographic setting

This survey occurred at access locations along the 63-mile Illinois shoreline of Lake Michigan (Figure 1), a highly-developed stretch of shoreline. Chicago covers roughly one-third of the Illinois shore, and a series of smaller cities cover most of the remainder. No significant tributary streams enter Lake Michigan in Illinois waters. The slope of the near-shore lake bottom is steeper in the northern part of Illinois waters than near Chicago, which forces boaters from Chicago to go considerably farther from shore to reach good salmon waters (deep and cold) during the summer than boaters departing from North Point Marina. Another geographic feature is the easy access to other states' waters for boaters (e.g., Wisconsin waters for boaters launching at North Point Marina and Indiana waters for anglers launching at Calumet Park). For this survey, data were assumed to represent anglers fishing in Illinois waters.

Figure 1. The Illinois shoreline of Lake Michigan.

METHODS

Non-charter angling activity was categorized into two groups that were evaluated separately: (1) Pedestrian and launched-boat anglers, for which data were generated via personal interviews and direct head counts, and (2) anglers using moored boats. The moored boat estimates presented here are based on extrapolating estimates for anglers using launched boats using data quantifying the distribution of moored-boat angling relative to launched-boat angling.

Pedestrians and launched-boat anglers

Effort and harvest were estimated for pedestrian and launched-boat anglers using selected primary fishing areas (i.e., selected shore access locations and boat ramps), and those estimates were extrapolated to other areas. For each primary fishing area, a modified stratified random sampling design similar to that suggested by Malvestuto (1996) was used. The primary sampling unit of the survey was the fishing day. Daily estimates (e.g., total harvest by species, expenditures by category, etc.) for each primary site were combined to estimate seasonal totals using the formula for stratified random samples given by Cochran (1977).

Use of primary fishing areas

The primary fishing areas for pedestrian anglers were North Point Marina (Winthrop Harbor), Waukegan Harbor (Waukegan), and four locations in Chicago: Montrose Harbor, Belmont Harbor, Jackson Park, and Calumet Park. The primary fishing areas for launched boats were boat ramps at North Point Marina (Winthrop Harbor), Waukegan Harbor (Waukegan), Diversey Harbor (Chicago), and Calumet Park (Chicago). For each day scheduled to be surveyed, a creel clerk was assigned to visit three areas, two pedestrian areas and one launch area, in a prescribed order. The three areas were always one of three groups: (1) Waukegan Harbor (pedestrians), North Point Marina (pedestrians), North Point Marina (launched boats); (2) Montrose Harbor (pedestrians), Belmont Harbor (pedestrians), Diversey Harbor (launched boats); and (3) Jackson Park (pedestrians), Calumet Park (pedestrians), Calumet Park (launched boats). Additional visits to the launch ramps at Waukegan Harbor were added to the design in 2006 and were surveyed in the same manner as the launch ramp sites in the three groups.

Estimates obtained for the primary fishing areas were extrapolated to all other areas of the Illinois shoreline based on the distribution of pedestrian anglers and boat trailers. Data describing these distributions were obtained via an annual series of aerial counts during helicopter flights (conducted on weekends during the spring and summer during 2004-2013; the helicopter usually used for flights was not available during 2014 or 2015). During each flight, pedestrian anglers were counted and recorded on a form divided by site and the type of pedestrian site: structure (piers and breakwalls), shore (shoreline) and harbor (inside enclosed harbors). Pedestrian anglers who were not at a recognized site were counted and listed in the vicinity of the closest recognized site; the sum of these became the total for "other areas" on the form. Boat trailers with a vehicle attached were counted in the parking lots of launch ramps and were listed on the form at the appropriate site. All of the data collected were combined for the period to

calculate an average percentage of total fishing effort occurring at each location (Table 2). Distribution data for the last 10 years were included to increase confidence in extrapolating estimates from primary fishing areas.

Distribution of fishing

Pedestrians and launched boats

The aerial survey documented angler use of 24 fishing areas (in addition to "other" areas; Table 2). During 2004 – 2013, these 24 areas accounted for 96.8% of the pedestrian anglers observed in the aerial surveys and 100% of the boat trailers parked near launch areas. Boats launched from the Calumet Yacht Club were not included in this survey (located in Illinois, but boats must leave the marina via Indiana waters). Interviews for the creel survey were conducted at six pedestrian fishing areas that accounted for 79.3% of the pedestrian anglers observed during the helicopter flights and four launch areas that accounted for 80.7% of the boat trailers observed near launch areas.

Table 2. Distribution of pedestrian anglers and boat trailers along the Illinois shoreline of Lake Michigan, determined by helicopter flights during 2004-2013.

Area	Pedestrian anglers (%)	Boat trailers (%)
1. IL Beach State Park & North Point Marina	1.3	35.5
2. Waukegan Harbor and breakwalls	8.4	30.1
3. Great Lakes Naval Training Station	0.2	0.3
4. Forest Park	0.0	1.4
5. Central Park	0.1	1.6
6. Winnetka (Lloyd and Tower Parks)	0.3	4.1
7. Wilmette Harbor	1.2	NA
8. Northwestern Univ. and Dawes Park	0.3	5.1
9. Farwell Avenue pier	1.1	NA
10. Hollywood Avenue pier	0.7	NA
11. Foster Avenue pier	0.6	NA
12. Montrose Harbor and breakwalls	57.8	NA
13. Belmont Harbor	5.8	NA
14. Diversey Harbor and breakwalls	1.6	7.3
15. North Avenue pier	0.0	NA
16. Navy Pier	0.4	NA
17. Monroe Street breakwalls	0.8	NA
18. Burnham Harbor and vicinity	8.1	5.9
19. McCormick Place seawall	1.0	NA
20. 31st Street	0.4	0.3
21. 50th Street access area	0.2	NA
22. 59th Street Harbor	0.6	NA
23. Jackson Park Harbor and breakwall	5.3	0.7
24. Calumet Park	0.8	7.8
25. other areas	3.2	0.0

Moored boats

In the Illinois portion of Lake Michigan, boats are moored at several locations: North Point Marina, Waukegan Harbor, Great Lakes Naval Training Station, Wilmette Harbor, and the Chicago Park District harbors. The number

of power boats kept at moorings was used as an index of fishing activity from moored non-charter power boats (Table 3). Some fishing may occur from sail boats, but we assumed that it was a negligible portion of all fishing. Two private lift services (referred to as I/O service in Table 3) were included in the survey: Larsen Marine at Waukegan Harbor and Skipper Bud's at North Point Marina. Boats kept at moorings or on land (lift service) in the Calumet or Chicago River systems were assumed to represent a negligible portion of fishing activity and were not included.

Table 3. Mooring locations along the Illinois shoreline of Lake Michigan and numbers of non-charter power boats moored at each location, as determined by the marinas and port authorities. Total number of power boats per port in bold.

Mooring area	Number of power boats
North Point Marina	**428**
Public Moorings	366
Skipper Bud's I/O service	62
Waukegan Harbor	**280**
Public Moorings	200
Larsen Marine I/O service	80
Great Lakes Naval Training Station	**54**
Wilmette Harbor	**119**
Chicago Park District	**2,791**
Diversey	682
other harbor moorings	2109

Early spring survey

Only two groups of sites were surveyed in the month of March. A group in Lake County consisted of Waukegan Harbor (pedestrians) and Waukegan Harbor (launched boats). A Chicago group consisted of Montrose Harbor (pedestrians), Calumet Park (pedestrians), and Calumet Park (launched boats). Virtually all the open boat ramps and the areas of heaviest concentrations of open water pedestrian anglers this early in the season were included in these groups (based on personal observations and previous surveys). Effort, harvest, and expenditures by moored-boat anglers were not estimated in the March survey because very few boats are at moorings at that time.

Selection of dates in a stratified random sample

The creel survey season (1 April through 30 September 2015, representing the major portion of fishing activity) was stratified by segment (three-week time periods) and type of day (weekends and holidays, or weekdays). The following 18 strata were formed:

1. Week days 4/1 - 4/19
2. Weekend days 4/1 - 4/19
3. Week days 4/20 - 5/10
4. Weekend days 4/20 - 5/10
5. Week days 5/11 – 5/31
6. Weekend days 5/11 – 5/31

7. Week days 6/1- 6/21	8. Weekend days 6/1- 6/21
9. Week days 6/22 - 7/12	10. Weekend days 6/22 - 7/12
11. Week days 7/13 – 8/2	12. Weekend days 7/13 – 8/2
13. Week days 8/3 - 8/23	14. Weekend days 8/3 - 8/23
15. Week days 8/24 - 9/13	16. Weekend days 8/24 - 9/13
17. Week days 9/14 - 9/30	18. Weekend days 9/14 - 9/30

For each of the three groups of sites, four survey dates were selected at random within each stratum, with the restriction that all three groups were sampled at least one week day (Monday through Friday) and one weekend day each week. For strata 1, 17 and 18, which were several days shorter than the others, fewer than four dates were selected for each group of sites. All three sites in each group were visited on the dates selected for that group. In addition to the surveys conducted at the three groups of sites, the launch ramps at Waukegan Harbor were surveyed three times per stratum, except during stratum 18, when only 2 visits were made.

The early spring survey was treated in a similar fashion to the core survey except that the segment duration was the entire month of March.

1. Week days 3/1 - 3/31	2. Weekend days 3/1 - 3/31

Data collection

Data were collected via two methods at each site: interviews during a two-hour period, and counts at the beginning and end of the two-hour period. Additionally, at boat launch sites, the arrival times of returning boats were recorded for all boats (whether interviews were conducted or not). Each interview was designed for one angling party i.e., one or more anglers fishing together) to increase the number of angling parties that could be interviewed and to minimize redundant questions within angling parties. At the eight pedestrian sites, the two-hour interview period was either 0600 to 0800 or 0830 to 1030. At the boat launch sites, the two-hour period was always 1100 to 1300. For pedestrian sites, individual anglers were counted at the beginning and end of each two-hour period. For boat launch sites, trailers (with vehicles attached, excluding personal watercraft trailers) were counted.

Creel clerks (who conducted the interviews) gathered information related to effort (number of angler-hours, number of angler-trips), expenditures for the present fishing trip (by category: major = boat, motor, or trailer; minor = fishing gear), zip code (to calculate distance driven to fishing locations, round-trip), harvest (by species), and species sought by angling parties. The species sought by anglers were grouped into four categories: Salmonids (including salmon and trout), yellow perch, other species (any species or group of species – e.g., “bass” – except salmonids and yellow perch), and unspecified (when the angling party was not targeting a specific species or group, i.e., “anything that bites”). Clerks also weighed and measured fish in possession of the anglers, noted whether each fish had sea lamprey wounds and scars, and noted any tags or marks (including clipped fins). The instructions to, and data form used by, creel clerks are in Brofka and Czesny (2008).

Calculation of round trip miles

The distance traveled by automobile was estimated for each angling party using Google Earth (Google Inc., 2015) in December, 2015. The "Get Directions" application was used to estimate distance from each party's zip code (using the location provided by Google Earth for that zip code) and the main parking area at the location where the angler was surveyed. As many drivers utilize Google for directions, these results likely closely match true distances driven, accounting for decisions to optimize both distance and travel time. The use of Google Earth instead of resulted in directions not influenced by traffic; while traffic likely is a factor influencing the route taken by anglers to fishing sites, traffic is always changing, and optimal routes accounting for traffic would likely be different at the time distance was estimated (long after the interview). The distance given by Google Earth was doubled to produce a round trip estimate. When anglers provided other locations instead of zip codes (e.g., city, neighborhood, or intersection), we used the "Get Directions" application in the same way, replacing the zip code with the given location. When anglers in a party traveled from separate zip codes, we used the zip code provided by the party leader (i.e., the angler providing most answers for the survey).

Variables measured for each date

Data collected during interviews were used to estimate the following variables for each date at each site: (1) Harvest per angler-hour, determined for each species by dividing the number of fish harvested by all parties interviewed by the number of hours of fishing by individuals in those parties; (2) Expenditures per angler-trip, categorized into major and minor categories. For all expenditures, total expenditures by all anglers interviewed were divided by the number of anglers interviewed; (3) Distance traveled (by automobile) per angler-trip. As for expenditures, the total, round-trip miles traveled by all anglers interviewed were divided by the number of anglers interviewed; (4) Angler-hours (i.e., total time spent fishing by all anglers; see following paragraph); (5) angler-trips (i.e., total number of anglers who fished; see following paragraph); (6) Total harvest was calculated for each species as harvest per angler-hour multiplied by angler-hours; and (7) total expenditures were determined for each category as expenditures per angler-trip multiplied by angler-trips.

Angler-hours and angler-trips were determined differently for pedestrians and boaters. For pedestrians, angler-hours was calculated by multiplying the average number of anglers (from counts at the beginning and end of each two-hour period) by the number of hours in the day (from 0.75 hour before sunrise to 0.75 hour after sunset), and angler-trips was calculated as angler-hours divided by the average duration of a pedestrian fishing trip (mean of 3.92 hours for all pedestrian interviews in 2015). The number of angler-trips for anglers using launched boats was estimated by multiplying the number of anglers returning on boats during the two-hour interview period by the ratio of the number of all boats returning in a day to the number returning between 1100 and 1300. By monitoring all boat traffic at North Point Marina on 6 days in 2015, the number of boats returning all day was estimated to be 3.186 times the number returning during 1100 to 1300 interview period. Launched-boat angler-hours were estimated by multiplying the number of angler-trips by the monthly mean trip duration. To smooth unrealistic differences between months, estimates of angler-trips were multiplied by the ratio of the annual mean to monthly mean of estimated anglers per trip. Estimates of angler-hours were multiplied by both this ratio and the ratio of annual mean

to monthly mean of hours per trip. In 2015, the annual mean number of anglers per boat was 2.30, and the annual mean trip duration for boat anglers was 5.73 hours.

Expansion of daily estimates

The formula given by Cochran (1977) for stratified random samples was used to expand daily estimates to seasonal site-specific estimates of effort, harvest, and expenditures. A different set of strata were used for expansion of estimates: we used month-long segments (e.g., April, May, June), each divided into weekend days and week days (instead of the three-week segments described above) and obtained monthly totals for each type of estimate.

Extrapolation to other areas

Extrapolations of seasonal estimates from primary fishing areas to other areas were based on the distributions of pedestrian anglers and boat trailers (assumed to reflect the distribution of launched-boat anglers; Table 2). Harvest, effort, and expenditures at areas not visited were estimated by extension of estimates for the nearest primary fishing areas. Thus, for pedestrian anglers, estimates for Waukegan Harbor were extended to all other areas north of and including Wilmette Harbor (except North Point Marina); estimates for Montrose Harbor were extended to all remaining areas north of Belmont Harbor; estimates for Belmont Harbor were extended to all remaining areas north of the Monroe Street breakwalls; estimates for Jackson Park were extended to all areas south of Monroe Street except for Calumet Park. For launched boats, estimates for Waukegan Harbor were extended to all launch ramps north of Wilmette (including the "other" areas listed in Table 2, but excluding North Point Marina); estimates for Diversey were extended to Dawes Park; and results for Calumet Park were extended to the ramps at Jackson Park, 31st Street Harbor, and Burnham Harbor.

Moored boats

Effort, harvest, and expenditure estimates for anglers using moored boats were extrapolated from calculations for launched boats. First, the ratios of moored fishing boats to launched fishing boats for North Point Marina and Diversey Harbor were estimated: On three dates during the spring and summer of 2014 the numbers of fishing boats returning to moorings were counted while, simultaneously, the numbers of fishing boats returning to the launch ramp were also counted. Charter boats were excluded from these counts. Due to low numbers of returning boats, the ratios of moored to launched boats were estimated using data from 2008-2015. These ratios were 0.797 in North Point Marina and 1.353 in Diversey Harbor.

Using these figures, seasonal estimates of effort, harvest, and expenditures by anglers using launched boats at North Point, Waukegan (ratio assumed to be equal to North Point Marina), and Diversey harbors were extrapolated to moored boats. Thus, for example, the moored boat effort at North Point Marina for a given segment was estimated to be the launched boat effort for that segment multiplied by 0.797. Based on the distribution of moored power boats, estimates for Waukegan Harbor were extrapolated to boats moored in Wilmette Harbor and Great Lakes

Naval Training Station, and the estimates for Diversey Harbor were extrapolated to all other boats moored in Chicago.

Changes in creel survey methods

Creel survey methods have varied during the past thirty years of the creel survey, so comparisons should be made with caution. In particular, estimation of round-trip miles differs from previous years. The influences of changes in methods will continue to be evaluated.

Confidence intervals and bias

Estimates of harvest, effort, and expenditures are presented without confidence intervals, as we have not fully evaluated bias in our estimates. Although we have collected and will continue to collect data with which to partially assess biases, assessing potential impacts on precision of estimates is not possible at this time.

Yield values

The term "yield value" is used in this report to describe the hypothetical market price of fish harvested by anglers (if sold as fillets). To estimate the yield value, the estimated harvest for each species was multiplied by the estimated mean weight of that species to produce an estimated round weight. That round weight was then multiplied by 0.4 (assuming 60% loss in filleting process in keeping with previous years' estimates; e.g., Roswell et al. 2015) to produce the harvested marketable weight for each species. The marketable weight for each species was then multiplied by species-specific prices (approximated using prices observed on the internet by C.R. Roswell, August 2016) to produce the market value of the 2015 harvest for each species.

Missing data

On some dates creel clerks were unable to complete their assigned interviews due to factors such as illness and vehicle break-downs. When data were missing from some of the assigned dates in a stratum, estimates for the stratum were based only on data from the surveyed dates. Thus, the sample size was smaller in these cases than for strata in which all interview sets were completed, and the resulting estimates were not as precise as estimates derived from full data sets. In 2015, all or some of the scheduled surveys were incomplete on fewer than 2% of all scheduled survey days.

Alternate sites/altered sites

Unforeseen circumstances (e.g., construction) have caused one or more primary sites to be closed or less accessible during part or all of many past sampling seasons. In 2015, there were a few minor disruptions (less than in many previous years at our creel locations). Ice remained in Waukegan harbor and Montrose into the second week of March, limiting pedestrian fishing activity and boat access. The fishing pier at North Point Marina was not accessible until April 15th. Access to Johnson pier at the north end of Waukegan harbor was periodically restricted during March and April. There were brief limitations in access to the Belmont and Jackson sites due to construction.

Dredging at the mouth of Waukegan harbor for much of the spring and summer did not limit access, but may have influenced fishing success and effort at the ends of Johnson and Government Piers at our Waukegan site.

Winter yellow perch survey

See Appendix B for methods of the winter yellow perch survey.

RESULTS

Overview

Estimates reported here are rounded; this may result in values for “totals” that differ slightly from the sum of individual values. For simplicity, the words "approximately" or “estimated” are not repeated with each estimated value. Detailed results for 2015 are presented in Tables 4 - 10. Tables 4 and 5 list seasonal harvest and effort (angler hours) estimates for anglers. Tables 6 and 7 present effort and harvest for each segment. Table 8 provides yield values. Table 9 lists fin clip abbreviations; fin clips observed by our creel clerks are listed in Table 10, with the number of occurrences of each clip or clip combination listed by species. Table 10 can assist in determining the contributions of different stockings of fish to the sport fishery in the Illinois portion of Lake Michigan. Tables 11 and 12 report angler trips and expenditures among angler types and among years. Tables 13 and 14 compare angler hours and harvest by fish species between angler types and for each year. Table 15 compares minor fish species harvest for each year.

Total April-September non-charter sport fishing effort in the Illinois portion of Lake Michigan was 320,963 angler-hours. Harvest for major species included 8,289 yellow perch, 34,856 coho salmon, 7,556 Chinook salmon, 3,342 rainbow trout, 2,418 lake trout and 1,448 brown trout (Table 4). Anglers spent $4.26 million during the study period for boats, motors, trailers, and fishing gear used on Lake Michigan fishing trips (Table 11). Anglers fishing Lake Michigan drove 2.45 million miles (round trip; Table 11). The Illinois sport fishing harvest was estimated to have a yield value of $1.37 million (Table 8).

Pedestrian fishing

From April 1 - September 30, 2015, pedestrian anglers spent 133,885 hours fishing in 34,111 trips to Lake Michigan (Table 4, Table 11). Coho salmon comprised the largest portion of the pedestrian harvest (9,663 fish; Table 4). Yellow perch angling was also an important component of the pedestrian fishery, with a harvest of 8,289 (Table 4). Pedestrian anglers spent $302,143 (mean = $8.86 per trip) for fishing gear and drove 1,142,899 miles (mean = 33.51 miles per round trip – to and from the lake shore; Table 11).

Boater fishing

Anglers using launched or moored boats made 32,484 trips to Lake Michigan (Table 11) and spent 187,079 hours fishing (Table 4). The most abundant components of boater harvest were coho salmon (25,192), Chinook salmon (7,093), and rainbow trout (3,039; Table 4). North Point Marina accounted for 32.0% of the salmonines (lake trout, brown trout, rainbow trout, Chinook salmon, and coho salmon) taken by all anglers who used boats, more than any other port (Table 4). See Appendix A for a comparison of the charter-boat fishery with non-charter boat angling. No yellow perch harvest by boat anglers was documented in our survey (Table 4). Total, fishing-related expenditures by anglers using boats were $3,953,236 ($121.70 per trip), with 85.4% of that amount spent on boats, motors, and trailers (Table 11). Boaters drove 1,303,955 round-trip miles (40.1 miles per trip; Table 11).

Yield values

The estimated yield values of the three most valuable (in total yield) sport species were $757,830 for Chinook salmon, $416,414 for coho salmon, and $93,738 for rainbow trout (Table 8). Aside from yellow perch harvested from the Wisconsin portion of Green Bay, none of the species listed in Table 8 are currently commercially available from Lake Michigan. Therefore, the values of all species are estimated from the retail prices for fish that are farm-raised or commercially-harvested in other waters. An estimated price for brown trout fillets was not available, so the price for lake trout fillets was used to estimate the yield value of brown trout.

Comparisons with preceding years

Compared to 2014, total angler fishing effort decreased by 11.6% in 2015 (Table 13). Boater effort increased 2.5%, while pedestrian effort decreased 25.8% (Table 13). Angler harvest rates for salmonids (number of fish per angler hour) decreased compared to 2014 for boat anglers, but increased for pedestrian anglers (Figure 2a). Boat and pedestrian angler harvest rates for yellow perch decreased compared to 2014 (Figure 2b); yellow perch harvest rates for both boaters and pedestrians were the lowest in the 30-year history of the survey. Total effort directed at salmonids was 235,346 angler-hours, with about 69% occurring from boats, similar to most years in the last decade (Table 4, Figure 3a). Total effort directed at yellow perch was 38,454 angler-hours, with boat anglers accounting for approximately 14%; both total perch-directed effort and the proportion of angler-hours comprised by boaters were much higher during 2006-2010 (Table 4, Figure 3b).

The yellow perch harvest of 8,289 was a drastic decrease of 84.8% from the 2014 harvest (Table 13 and Figure 4). The average weight of yellow perch kept by anglers decreased to 222 g (0.49 lb.; Table 8), and average length decreased slightly to 259 mm (Figure 5). As in 2014, yellow perch fishing for boat anglers was essentially nonexistent near Waukegan in 2015, despite high harvest there less than a decade ago. Pedestrian harvest of yellow perch peaked in June (46.9% of pedestrian harvest), and most of the pedestrian harvest for the entire period occurred at our Montrose site (74.6% of overall pedestrian harvest; Table 6). In 2015, monthly contributions to total harvest were similar (as a percent of total harvest) to the ten-year mean monthly patterns (Figure 6).

The 2015 harvest of coho salmon increased by 15.0% compared to 2014 (Table 13 and Figure 7). Weight (1,007 g, or 2.22 lb.) of creeled coho salmon decreased 12.2% and length (472 mm) decreased 2.7% compared to 2014 (Table 8 and Figure 8). The majority (79.7%) of the harvest occurred in April and May (Tables 6 and 7).

The Chinook salmon harvest was 7,556 fish for 2015, an increase of 50.8% from 2014 (Table 13 and Figure 9). Average length was 724 mm, a decrease of 0.3% compared to 2014, but the average weight increased 5.0% compared to2014, to 4,468 g (9.85 lb.; Table 8 and Figure 10). Most (51.5%) of Chinook salmon harvest occurred in August (Tables 6 and 7).

The 2015 harvest of lake trout was 2,418, a 43.7% decrease from harvest in 2014 (Table 13). The average weight increased by 7.3% and average length increased by 0.6% compared to 2014 (Table 8). Lake trout harvest peaked in June and July (51.1% of total harvest; Tables 6 and 7).

The 2015 brown trout harvest (1,448) decreased by 76.2% from 2014 (Table 13). The average length (501 mm) decreased by 10.7% compared to 2014 and the average weight of 1,715 g (3.78 lb.) decreased by 35.7% (Table 8). The majority (93.9%) of the harvest occurred in April and May (Tables 6 and 7).

The 2015 rainbow trout harvest (3,342) decreased from 2014 by 51.1% (Table 13). The average length of 625 mm was an increase of 0.6% compared to creeled rainbow trout in 2014, and weight (2,356 g, or 5.19 lb.) decreased 13.0% (Table 8). More harvest occurred in June, July and August than in other months (67.2%; Tables 6 and 7).

Estimated expenditures for boats, motors, and trailers decreased by 41.4% compared to 2014 (Table 11). Minor expenditures (i.e., fishing tackle) decreased by 22.9% and total mileage increased by 22.6%.

The 2014 early spring (March) survey saw an increase of 19.9% in angling effort compared to March of 2014. Overall harvest of salmonines was higher than for March of 2014: brown trout harvest increased 1068.5% but coho salmon harvest decreased 5.4%. Rainbow trout harvest was 0 fish (compared to 15 in March of 2014). No yellow perch, lake trout, or Chinook salmon were harvested in the month of March in either 2014 or 2015 (Table14).

Seasonal patterns in salmonid harvest and effort

The majority of salmon and trout were harvested in April and May (65.1%; Figure 11a, b). The majority of brown trout and coho salmon harvest occurred in April and May (93.9% and 79.7%, respectively). The summer months (June, July, and August) accounted for most lake trout and rainbow trout harvest (62.9% and 67.2%, respectively). Over half of the Chinook salmon harvest occurred during August (51.5%). Salmonid-directed effort by pedestrians was high during April, May, and September, and much lower during June-August. Boater salmonid effort was highest during May and lowest during September, with intermediate levels occurring during April, June, July, and August.

Yellow perch year class contributions to the fishery

An index of year class contributions to the yellow perch fishery was calculated by multiplying annual harvest per unit effort (shown in Figure 2b) by proportions of harvest comprised of each year class (data collected through project F-123, most recently reported in Dub and Czesny 2016). Only pedestrian data were used, as boat data from both sources have been inconsistently collected in recent years. The result is an estimated harvest per unit effort for each combination of year class and year of harvest. Figure 12 shows the peak HPE for each year class, along with the age at which peak HPE occurred. Typically, HPE in a year class peaks at age 3 or 4, followed by declining HPE as the year class ages to 5 years and beyond. Thus, only year classes for which HPE estimates were available for ages 3, 4, and 5 (year classes 2002 – 2010) are shown in Figure 12. Results indicate the 2002 and 2003 year classes made larger than average contributions to pedestrian yellow perch harvest rates, while the 2010 year class made a contribution at an intermediate level, with several consecutive poor year classes in between.

Minor species

In addition to the species for which results are presented in detail in Tables 4 - 14 (commonly-encountered salmonids and yellow perch), creel clerks reported the catch and/ or harvest of several other species by anglers (referred to here as "minor species"; Table 15). For some species, the total number of fish harvested (and total numbers caught) were estimated. For other species, very few fish were observed, so only the actual number observed in anglers' possession by creel clerks during interviews is reported. Most of these "minor" species were harvested in or near the harbors. Minor species harvested (total caught in parentheses) include: **round goby**, 18,803 (21,576); **freshwater drum**, 2,786 (3,095); **rock bass**, 284 (679); **common carp**, 121 (443); **bluegill**, 76 (360); **alewife**, 35 harvested fish observed; **channel catfish**, 3 harvested fish observed. Additionally, an estimated 5,721 **smallmouth bass** and 88 **largemouth bass** were released (none harvested).

Winter yellow perch survey

See Appendix B for results of the winter yellow perch survey.

DISCUSSION

Changes in the fishery and the creel survey in 2015

The primary purpose of this report is to report data summaries and other information from a long-term project to fisheries scientists and managers. As such, much of the data collection, analyses, and reporting is very similar to previous years. This provides a better comparison with previous years' data, enabling a more complete understanding of inter-annual trends in the fishery. However, some minor changes have occurred as a result of changing information needs and changes in the fishery (e.g., access and regulation changes).

Unlike previous years (through 2011), formal estimates of vehicle fuel costs were not included in this report. Prior to 2012, an estimate of $0.10 per mile for fuel was applied to the total miles driven by anglers to and from creel

locations. Due to changes in gas prices, this likely would underestimate the actual amount spent by anglers on vehicle fuel. One approach to estimating fuel costs, used by Melstrom and Lupi (2013) as part of a model estimating the value of Great Lakes recreational fishing, uses rates published annually by AAA (AAA 2015). Average gas cost reported by AAA was $0.1121 per mile in 2015 (AAA 2015). Melstrom and Lupi (2013) added $0.05 per mile for vehicles towing trailers to account for increased fuel consumption; employing this approach produces an estimate of $0.1621 per mile for vehicles towing trailers in 2015. Applying the average rate for pedestrian and moored boat anglers' round-trip miles, and the vehicle-with-trailer rate for launched boat anglers' miles, produces estimated fuel costs of $307,842 for all anglers fishing Illinois waters of Lake Michigan during April – September, 2015. This is more than an estimated total of $288,612 in fuel costs for 2014 (using AAA's 2014 rate).

Another change related to vehicle fuel costs was the use of zip codes to estimate round-trip miles for angling trips (see Methods).

An important change to the fishery in 2015 was the establishment of a closed season for yellow perch fishing from May 1 – June 15. Previously (2001 – 2013), fishing for yellow perch was not permitted during the month of July (except for children under 16, with a reduced bag limit, since 2007), and in 2014 there was no closed season for yellow perch. In 2015, June and July accounted for 45.8% and 30.6%, respectively, of angler hours directed at yellow perch. Some illegal perch-directed angling was observed (e.g., 3.5% of perch angling effort occurred in May). June accounted for 46.9% of yellow perch harvest, but July accounted for only 8.1% of harvest, despite an open season during a typically productive month for yellow perch harvest. A small uptick in yellow perch harvest was observed in August, which accounted for 22.6% of the April – September harvest. In 2014, 42.9% of yellow perch harvest and 38.4% of perch-directed angling effort occurred in July, while in 2013 (during the July closure period), July accounted for only 20.0% of yellow perch harvest and 10.0% of perch-directed effort. Thus, the opening of July to yellow perch angling has continued to increase yellow perch angling effort during that month, but low angler success for perch in July of 2015 contributed to the lowest total April-September yellow perch harvest on record. This is also significant because 2013, 2014, and 2015 have been the three worst years for yellow perch harvest since 2000.

Angler effort

Total angler fishing effort (indexed by angler-hours) increased 2.5% for boats and decreased 25.8% for pedestrians compared to 2014. Effort has generally been declining since this survey began in 1986. While effort increased slightly from 2011 to 2012, total effort in 2014 was similar to levels in 2011, and total angler effort in 2015 was the lowest on record (1986-2015), suggesting the trend of decreasing angler effort has not reversed.

Yellow perch

Annual yellow perch harvests by anglers in Illinois have varied substantially over time. Estimated angler harvest was well over one million fish each year from 1986 through 1993 (except 1989). However, harvest fell to fewer than 600,000 in 1994, and by 1997 fell to well under 60,000 (driven in part by regulation changes and reduced effort; Brofka and Dettmers, 1999). Harvest increased somewhat in 2001 (to 169,967) in response to increased effort and new regulation changes (repeal of an unprotected slot limit and moving the month closure from June to July). Yellow perch harvest generally increased from 2002 through 2008 to around 300,000, but then declined, and has been under 100,000 fish for the last five years (2011-2015). The mean April-September yellow perch harvest during 2006-2015 was 165,371; however, the mean harvest during 2011-2015 was 53,303, less than one-third of the ten-year mean. Harvest in 2015 decreased 84.0% from 2014 for pedestrian anglers and decreased 100% for boat anglers (no boat harvest observed; decrease of 84.8% combined pedestrian and boat harvest). The 2015 harvest of 8,289 yellow perch was far below the previous low for April-September total yellow perch harvest, which occurred in 1998 (35,936 fish). Overall effort directed at yellow perch decreased 57.6%, and overall HPE (harvest per angler effort expressed in fish-per-angler-hour) was 0.22 yellow perch per angler-hour, 64.2% lower than 2014 HPE (and the lowest on record for our survey).

The results in Figure 12 provide an index of year class strength in harvest, an ultimate endpoint for the fishery. This differs from simple estimates of age composition in a given harvest year, as it allows comparisons across years of harvest. For example, the 2010 year class of yellow perch represented 74% of the harvest in 2014 (Dub and Czesny 2016) while the 2003 year class comprised only 40% of harvest at its peak in 2007 (J. Dub, personal communication), but because overall harvest rates were much lower in 2014, the overall contribution to the fishery by the 2010 year class was much lower than that made by the 2003 year class. It should be noted that the HPE of each year class is not independent of adjacent year classes. That is, when consecutive strong year classes occur (such as the 2002 and 2003 year classes), a buffering effect likely lowers the HPE for those year classes, while a year preceded and followed by weak year classes (the 2010 year class, for example), may be especially vulnerable to high harvest rates. Therefore, the year- and age-specific HPE used this way likely underestimates true variation in availability of perch to anglers, further emphasizing the importance of the 2002 and 2003 year classes to the pedestrian fishery, and the lack of strong year classes in subsequent years.

Coho salmon

Coho salmon consistently comprise the largest part of both the boat and pedestrian salmonid fishery. Coho salmon typically make up about 64% of the boater salmonid harvest, and in 2015 accounted for 70.2% of salmonids harvested by the overall non-charter angling fishery. The 2014 harvest of 34,856 coho salmon was 15.0% higher than harvest in 2014. Mean weight of harvested coho salmon during 2015 was 1,007 g, 32.2% lighter than the thirty-year mean.

Other salmonids

While the coho salmon harvest has traditionally dominated spring and early-summer salmonid harvest, other salmonids (especially Chinook salmon) often make up the large portions of the harvest during mid-summer through early fall. Chinook salmon are popular, as they can attain very large sizes and provide anglers with a good fight. The annual Chinook harvest has fluctuated through time. Bacterial kidney disease (BKD) was blamed for die-offs of Chinook salmon beginning in 1988, resulting in reduced angler harvest of Chinook salmon, (as low as 2,900 fish in 1994). Chinook salmon have since been closely monitored in the hatchery and in the wild for BKD (Clark, 1996). Harvest in 2015 increased by 50.8% (7,556) compared to 2014, but remained below the ten-year mean harvest (2006-2015) of 9,051 fish. Mean weight increased 5.0% from to 2014 to 4,468 g (9.85 lbs.).

Lake trout harvest peaked in 1998 at 12,000, while the lowest harvest occurred in 2006 (653). Lake trout harvests have generally trended up in recent years, following a period of relatively low harvest during 2003-2010. The mean lake trout harvest for the past ten years is 2,117 fish; the mean harvest for 2011-2015 is 3,263 fish. In 2015 the harvest was 2,418 fish, making 2015 the fifth consecutive year with harvest above the ten-year mean; however, the 2015 harvest falls below the thirty-year mean harvest of 3,465 fish.

Brown trout are an important component of the spring salmonid fishery with a ten-year mean harvest (2006-2015) of 2,813 fish. The 2015 harvest of 1,448 browns was a decrease of 76.2% from the 2014 harvest. The mean weight decreased from 2014 to 1,715 g (3.78 lbs.).

Rainbow trout are a component of the spring and summer fishery. Typically, most rainbow trout harvest occurs in the boat fishery. The average annual harvest for the past ten years has been 3,351. 2015 saw a decrease of 51.1% compared to 2014 with a harvest of 3,342 fish. The mean weight decreased to 2,356 g (5.19 lbs.) in 2015, which is 13.0% smaller than the mean weight of rainbow trout harvested in 2014.

Minor species

Some species provide a smaller, yet consistent component of the fishery. The national B.A.S.S. tournament held at Burnham Harbor July 19 - 23, 2000 is evidence that anglers nationwide are aware of opportunities to catch black bass (smallmouth and largemouth bass) in the harbors and shoreline of the Illinois portion of Lake Michigan. Common carp and freshwater drum are targeted both by anglers fishing for food and catch-and-release anglers using European carp tournament fishing techniques. Panfish (other than yellow perch) are targeted or kept incidentally by pedestrian anglers; rock bass harvest has averaged about 2% of the annual yellow perch harvest for the last ten years, representing the largest component of the non-perch panfish fishery. Estimated harvests of rock bass and freshwater drum have generally been similar in scale to estimates of harvest for brown, lake, and rainbow trout for the past 10 years. Approximately 7.3% of total angling effort was directed at minor species in 2015 (i.e., “other” recorded as the species sought during interviews).

Expenditures

Expenditures decreased in 2015, while mileage increased. Major expenditures (i.e., boat, motor and trailers) decreased 44.9% and minor expenditures (i.e., tackle, bait, downriggers, etc.) decreased 22.9%, consistent with general declining trends since 2006. Mileage (round-trip, to and from access sites) increased 22.6%, despite a declining trend in angler-trips and total miles estimates for the last decade. Caution should be used when considering differences in mileage due to changes in methods. Collecting zip codes to estimate round trip mileage potentially allows additional future evaluations angler travel, but may lead to different results for total mileage than using angler-reported mileage (as used in previous years). Evaluating mean mileage per trip in future years may provide insight into relative biases of the zip code method.

Early spring (March) survey

Fishing effort and success during March is heavily influenced by the weather and the severity of the winter preceding March. For example, March of 2012 was one of the warmest on record for this region, resulting in the highest March angling effort of the last ten years, and above-average harvest of yellow perch, coho salmon, and brown trout. The preceding year (2011) had been cooler, and ice limited angling at Waukegan Harbor, resulting in reduced effort, and subsequently low yellow perch and brown trout harvests. During 2013, 2014, and 2015, March was characterized by cool temperatures, and 2014 and 2015 followed particularly cold winter periods. Effort in March of 2015 was the third-lowest of the last 10 years, but increased slightly from March, 2014. However, March harvest in 2015 was higher than the ten-year mean for brown trout and coho salmon. As in March, 2014, no perch were harvested in March of 2015; March yellow perch harvest previously ranged between 28 and 19,928 fish during 2006-2013.

Winter yellow perch survey

See Appendix B for discussion of the winter yellow perch survey results.

ACKNOWLEDGMENTS

We thank Vic Santucci, Dan Makauskas, and Steve Robillard for coordination, advice, and review of this report; Diane Wudi for administrative tasks; and Justin Bopp, Josh Dub, Elizabeth Golebie, Chris Hoffman, Nate Jermain, Rebecca Lake, Joel Lauritsen, Tom Moran, Rachel Moss, and Rebecca Rogers for their long hours collecting data. We also thank the staff of Chicago Harbors, Wilmette Harbor Association, Naval Station Great Lakes, Waukegan Port District, Larsen Marine, North Point Marina, and Skipper Bud's North Point for assistance with moored boat estimates.

REFERENCES

AAA (American Automobile Association). 2015. Your driving costs: how much are you really paying to drive? 2015 edition. AAA Association Communication, Heathrow, Florida. Available: http://exchange.aaa.com/wp-content/uploads/2015/04/Your-Driving-Costs-2015.pdf. (September 2016).

Roswell, C.R. and S.J. Czesny. 2015. A survey of sport fishing in the Illinois portion of Lake Michigan - March through September, 2014. INHS Technical Report 2015 (13). Illinois Natural History Survey, Champaign, Illinois, 38pp.

Brofka, W.A. and S.J. Czesny. 2008. A survey of sport fishing in the Illinois portion of Lake Michigan - March through September, 2007. INHS Technical Report 2008 (16). Illinois Natural History Survey, Champaign, Illinois, 57pp.

Brofka, W.A., and J.M. Dettmers. 1999. A survey of sport fishing in the Illinois portion of Lake Michigan - March through September, 1998. Aquatic Ecology Technical Report 99/03. Illinois Natural History Survey, Champaign, Illinois, 56pp.

Clark, R. 1996. Status of chinook salmon in the upper Great Lakes. Lake Michigan Committee, 1996 Annual Meeting, Great Lakes Fisheries Commission. p. 153 - 160.

Cochran, W.G. 1977. Sampling techniques, 3rd ed. John Wiley and Sons, New York. 428 pp.

Dub, J.D. and S.J. Czesny. 2016. Yellow Perch Population Assessment in Southwestern Lake Michigan July 1, 2014- June 30, 2015. INHS Technical Report 2016 (xx). Illinois Natural History Survey, Champaign, Illinois, 37pp.

Google. Inc. 2015. *Google Earth*. Downloaded at: https://www.google.com/earth/

Malvestuto, S.P. 1996. Sampling the recreational creel. Pages 591-624 in B. R. Murphy and D. W. Willis, eds., Fisheries Techniques Second Edition. American Fisheries Society. Bethesda, Maryland. 1996.

Melstrom, R.T. and F. Lupi. 2013. Valuing Recreational Fishing in the Great Lakes. North American Journal of Fisheries Management 33: 1184-1193.

Muench, B. 1981. 1979 sport fishing creel survey on the Illinois portion of Lake Michigan. Division of Fisheries, Illinois Department of Conservation (mimeo). 17 pp.

Table 4. Effort (anglers-hours) and harvest (by species) by non-charter anglers in the Illinois portion of Lake Michigan during April-September, 2015. Wau. = Waukegan, Peds = Pedestrian.

		Effort			Harvest					
Type of angler	Area	Total hours	Target perch	Target salmon	Yellow perch	Brown trout	Rainbow trout	Lake trout	Coho salmon	Chinook salmon
Peds	North Point	1,017	0	128	0	0	0	0	0	0
	Wau. Harbor	13,395	459	9,948	0	147	112	0	1,268	45
	Montrose	63,839	21,578	27,280	6,182	238	104	0	3,032	283
	Belmont	4,353	1,524	2,259	492	15	30	0	243	18
	Jackson	10,438	2,137	6,613	315	83	0	0	1,050	14
	Calumet	3,932	248	2,562	0	22	0	0	619	31
	others	36,911	7,206	23,132	1,300	288	57	0	3,451	73
	TOTALS	133,885	33,152	71,922	8,289	793	303	0	9,663	464
Boat	North Point	60,180	0	59,074	0	58	2,065	1,169	7,732	1,262
	Wau. Harbor	47,672	185	47,018	0	97	604	593	6,767	632
	Diversey	13,084	0	10,031	0	145	15	134	2,152	1,575
	Calumet	10,367	3,097	2,592	0	8	41	0	693	50
	others	55,776	2,020	44,709	0	348	314	522	7,848	3,574
	TOTALS	187,079	5,302	163,424	0	656	3,039	2,418	25,192	7,093
Combined	TOTALS	320,964	38,454	235,346	8,289	1,449	3,342	2,418	34,855	7,557

Table 5. Effort (anglers-hours) and harvest (by species) by non-charter anglers at selected sites along the Illinois portion of Lake Michigan during March, 2015. Wau. = Waukegan, Cal. = Calumet, Peds = Pedestrian.

	Effort			Harvest					
Location	Total hours	Target perch	Target salmon	Yellow perch	Brown trout	Rainbow trout	Lake trout	Coho salmon	Chinook salmon
Wau. Harbor	1,018	0	908	0	83	0	0	42	0
Wau. Ramp	384	0	384	0	584	0	0	0	0
Montrose	3,306	0	3,306	0	82	0	0	526	0
Cal. Park Peds	1,630	24	1,535	0	34	0	0	186	0
Cal. Park Ramp	1,346	0	1,346	0	70	0	0	541	0
Total	7,684	24	7,480	0	853	0	0	1,295	0

Table 6. Effort and harvest for each month by pedestrian anglers of the Illinois portion of Lake Michigan during April-September, 2015. Wau. = Waukegan.

		Effort	Harvest							
Time Period	Area	Total hours	Target perch	Target salmon	Yellow perch	Brown trout	Rainbow trout	Lake trout	Coho salmon	Chinook salmon
April	North Point	43	0	0	0	0	0	0	0	0
	Wau. Harbor	2,282	0	2,282	0	33	46	0	410	0
	Montrose	13,201	133	11,861	295	199	29	0	1,530	0
	Belmont	1,728	38	1,563	8	15	7	0	186	0
	Jackson	3,854	0	3,611	0	83	0	0	941	0
	Calumet	2,538	0	2,359	0	22	0	0	619	0
	others	12,185	21	11,428	17	244	21	0	2,754	0
May	North Point	153	0	0	0	0	0	0	0	0
	Wau. Harbor	3,875	15	3,558	0	113	0	0	813	0
	Montrose	10,739	364	8,165	359	23	33	0	1,409	78
	Belmont	395	0	231	0	0	0	0	46	0
	Jackson	491	0	354	0	0	0	0	68	0
	Calumet	237	0	85	0	0	0	0	0	0
	others	3,380	19	2,766	17	43	2	0	564	4
June	North Point	108	0	41	0	0	0	0	0	0
	Wau. Harbor	1,017	13	438	0	0	0	0	0	0
	Montrose	13,160	9,638	723	2,309	17	0	0	0	0
	Belmont	991	937	0	371	0	0	0	0	0
	Jackson	1,456	944	70	266	0	0	0	0	0
	Calumet	321	45	0	0	0	0	0	0	0
	others	5,176	3,277	348	940	1	0	0	0	0
July	North Point	159	0	5	0	0	0	0	0	0
	Wau. Harbor	1,006	431	90	0	0	0	0	0	0
	Montrose	9,294	5,302	355	353	0	0	0	0	0
	Belmont	474	408	0	93	0	0	0	0	0
	Jackson	1,406	1,043	0	50	0	0	0	0	0
	Calumet	369	0	0	0	0	0	0	0	0
	others	4,668	3,244	67	180	0	0	0	0	0
August	North Point	369	0	0	0	0	0	0	0	0
	Wau. Harbor	1,256	0	553	0	0	24	0	0	36
	Montrose	8,475	4,838	257	1765	0	0	0	0	0
	Belmont	279	142	0	20	0	0	0	0	0
	Jackson	689	140	241	0	0	0	0	0	0
	Calumet	274	45	94	0	0	0	0	0	0
	others	2,775	578	898	92	0	9	0	0	13
September	North Point	185	0	82	0	0	0	0	0	0
	Wau. Harbor	3,961	0	3,027	0	0	41	0	45	9
	Montrose	8,969	1,301	5,920	1100	0	43	0	93	205
	Belmont	488	0	465	0	0	23	0	11	18
	Jackson	2,543	10	2,338	0	0	0	0	41	14
	Calumet	194	159	24	0	0	0	0	0	31
	others	8,727	66	7,624	53	0	26	0	133	56

Table 7. Effort and harvest by anglers using boats of the Illinois portion of Lake Michigan during April-September, 2015. Wau. = Waukegan.

		Effort			**Harvest**					
Time period	Area	Total hours	Target perch	Target salmon	Yellow perch	Brown trout	Rainbow trout	Lake trout	Coho salmon	Chinook salmon
April	North Point	2,457	0	2,457	0	26	0	20	615	0
	Wau. Harbor	8,393	0	8,393	0	61	0	68	1,256	0
	Diversey	3,217	0	2,902	0	0	15	48	1,168	483
	Calumet	2,329	123	1,890	0	8	0	0	554	37
	others	12,157	129	11,054	0	32	30	128	3,426	1,037
May	North Point	12,144	0	12,144	0	13	392	98	3,187	165
	Wau. Harbor	12,692	0	12,692	0	0	86	115	3,631	86
	Diversey	4,590	0	4,317	0	145	0	0	956	0
	Calumet	1,638	550	125	0	0	0	0	98	0
	others	16,164	412	14,467	0	301	35	47	3,557	35
June	North Point	14,624	0	14,624	0	0	518	301	2,968	436
	Wau. Harbor	9,621	0	9,621	0	11	111	170	1,450	179
	Diversey	0	0	0	0	0	0	0	0	0
	Calumet	3,005	1,664	60	0	0	0	0	0	0
	others	6,574	1,103	4,622	0	4	45	69	594	73
July	North Point	12,953	0	12,106	0	0	445	538	446	177
	Wau. Harbor	7,063	185	6,878	0	0	185	112	296	223
	Diversey	804	0	501	0	0	0	0	0	0
	Calumet	2,158	760	185	0	0	41	0	41	0
	others	6,452	376	4,849	0	0	112	46	157	91
August	North Point	12,129	0	12,067	0	8	514	129	357	357
	Wau. Harbor	5,757	0	5,289	0	0	170	112	112	89
	Diversey	3,116	0	1,352	0	0	0	0	0	1,092
	Calumet	854	0	0	0	0	0	0	0	0
	others	9,577	0	5,750	0	0	70	46	46	2,304
September	North Point	5,873	0	5,677	0	11	196	83	158	127
	Wau. Harbor	4,145	0	4,145	0	26	51	17	21	55
	Diversey	1,357	0	959	0	0	0	86	29	0
	Calumet	384	0	333	0	0	0	0	0	13
	others	4,852	0	3,967	0	11	21	186	68	34

Table 8. Yield values of fish harvested by non-charter sport anglers in the Illinois waters of Lake Michigan during April - September 2015. All fish are assumed to be prepared as fillets with 60% waste. Prices for all except brown trout (used lake trout value) are those current in national markets in August, 2016.

Species	Total harvest	Av. wt. (lbs.)	Round wt. (lbs.)	Market wt. (lbs.)	Price per pound	Yield value
Yellow perch	8,289	0.49	4,060	1,624	$17.69	$28,734
Brown trout	1,449	3.78	5,478	2,191	$8.50	$18,626
Rainbow trout	3,342	5.19	17,359	6,944	$13.50	$93,738
Lake trout	2,418	6.74	16,289	6,516	$8.50	$55,382
Coho salmon	34,855	2.22	77,400	30,960	$13.45	$416,414
Chinook salmon	7,557	9.85	74,443	29,777	$25.45	$757,830

Combined yield value of all species: $1,370,724

Table 9. Fin clip abbreviations.

Name of fin or bone	Abbreviation
Adipose fin	ad
Dorsal fin	do
Left maxillary bone	lm
Right maxillary bone	rm
Left pectoral fin	lp
Right pectoral fin	rp
Left ventral fin	lv
Right ventral fin	rv

Table 10. Fin clip summary for salmonids harvested by non-charter anglers in the Illinois waters of Lake Michigan during 2015. Typically, only a portion of the salmonids stocked each year are marked. However, all stocked lake trout are clipped. Lake trout examined by clerks which exhibit no fin clips are one of four possibilities: 1. the lake trout is naturally produced (wild). 2. the lake trout failed to receive a fin clip in the hatchery. 3. the lake trout regenerated the missing fin or fins. 4. the clerk did not examine the lake trout thoroughly enough and missed the clip or clips.

	Species				
Clip	Brown trout	Rainbow trout	Lake trout	Coho salmon	Chinook salmon
ad	0	4	7	1	19
ad, rp	0	1	0	0	0
ad, lv	1	0	0	0	0
do	0	0	0	1	0
lp	0	0	2	0	0
lp, rv	0	0	5	0	0
rp	0	0	3	0	0
rp, lv	0	0	2	0	0
lv	0	0	5	0	0
rv	0	1	0	0	0
no clip	35	88	24	467	45
ad	0	4	7	1	19

Table 11. Estimated number of angler trips and expenditures by non-charter anglers in the Illinois portion of Lake Michigan, during 2006 - 2015. In previous years, expenditure estimates were rounded to the nearest $1,000 (or 10,000 miles); 2013 - 2015 estimates were rounded to the nearest whole-dollar amount (or mile). NA = not applicable.

		Effort	Expenditures		
Type of angler	Year	(angler-trips)	Major (boat)	Minor (gear)	Miles (travel)
Pedestrians	2006	74,719	NA	$973,000	1,240,000
	2007	75,041	NA	$477,000	1,290,000
	2008	83,841	NA	$1,128,000	1,440,000
	2009	90,555	NA	$900,000	1,650,000
	2010	61,303	NA	$502,000	1,040,000
	2011	40,781	NA	$163,000	730,000
	2012	52,758	NA	$266,000	910,000
	2013	44,709	NA	$300,173	891,196
	2014	45,078	NA	$374,365	888,160
	2015	34,111	NA	$302,143	1,142,899
Boats	2006	52,277	$12,293,000	$2,116,000	1,740,000
	2007	42,034	$6,914,000	$600,000	1,040,000
	2008	47,636	$2,949,000	$1,469,000	1,360,000
	2009	41,349	$7,584,000	$624,000	1,230,000
	2010	55,701	$12,171,000	$895,000	1,760,000
	2011	37,061	$2,320,000	$532,000	1,230,000
	2012	44,863	$1,668,000	$912,000	1,510,000
	2013	36,575	$750,284	$424,726	1,285,864
	2014	32,471	$6,124,859	$765,368	1,107,217
	2015	32,484	$3,377,158	$576,078	1,303,955
Season Totals	2006	126,996	$12,293,000	$3,089,000	2,980,000
	2007	117,075	$6,914,000	$1,077,000	2,330,000
	2008	131,477	$2,949,000	$2,597,000	2,880,000
	2009	131,904	$7,584,000	$1,524,000	2,880,000
	2010	117,004	$12,171,000	$1,397,000	2,800,000
	2011	77,842	$2,320,000	$695,000	1,960,000
	2012	97,621	$1,668,000	$1,178,000	2,420,000
	2013	81,284	$750,284	$724,899	2,177,060
	2014	77,549	$6,124,859	$1,139,733	1,995,377
	2015	66,595	$3,377,158	$878,221	2,446,854

Table 12. March fishing effort and expenditures by non-charter anglers at selected sites in the Illinois portion of Lake Michigan, during 2006 – 2015. In previous years, expenditure estimates were rounded to the nearest $1,000 (or 1,000 miles); 2013 - 2015 estimates were rounded to the nearest whole-dollar amount (or mile). NA = not applicable.

		Effort	Expenditures		
Type of angler	Year	(angler-trips)	Major (boat)	Minor (gear)	Miles (travel)
Pedestrians	2006	3,378	NA	$38,000	70,000
	2007	2,812	NA	$26,000	50,000
	2008	1,656	NA	$33,000	30,000
	2009	1,750	NA	$42,500	40,000
	2010	2,292	NA	$51,400	51,000
	2011	1,667	NA	$5,300	27,000
	2012	4,517	NA	$47,400	85,000
	2013	611	NA	$3,846	15,081
	2014	1,309	NA	$10,469	25,284
	2015	1,517	NA	$12,197	35,052
Launched Boats	2006	594	$0	$33,000	12,000
	2007	835	$0	$36,000	8,000
	2008	605	$0	$37,000	9,000
	2009	1,925	$514,000	$61,000	50,000
	2010	2,067	$993,000	$83,000	55,000
	2011	215	$1,599,000	$400	3,000
	2012	1,417	$0	$16,400	31,000
	2013	259	$0	$502	2,145
	2014	207	$276,616	$13,255	2,063
	2015	300	$0	$5,020	6,388
March Totals	2006	3,972	$0	$71,000	82,000
	2007	3,647	$0	$62,000	58,000
	2008	2,261	$0	$70,000	37,000
	2009	3,675	$514,000	$103,000	90,000
	2010	4,359	$993,000	$135,000	106,000
	2011	1,882	$1,599,000	$5,700	30,000
	2012	5,934	$0	$63,800	116,000
	2013	870	$0	$4,348	17,226
	2014	1,516	$276,616	$23,724	27,347
	2015	1,817	0	$17,217	41,440

Table 13. Fishing effort and harvest by non-charter anglers in the Illinois portion of Lake Michigan, in 2006 - 2015. Estimates were rounded to the nearest whole number. Peds = Pedestrian anglers, Boat = Boat anglers.

		Effort	Harvest					
Angler type	Year	(angler-hours)	Yellow perch	Brown trout	Rainbow trout	Lake trout	Coho salmon	Chinook salmon
Peds	2006	276,536	188,535	692	304	0	348	2,734
	2007	251,912	216,437	1,110	311	34	491	2,543
	2008	284,555	144,144	1,854	395	0	2,179	2,313
	2009	325,802	147,941	745	507	0	2,366	2,922
	2010	231,121	93,986	630	384	0	4,712	1,755
	2011	169,723	33,071	664	312	0	4,759	1,155
	2012	207,171	74,406	878	22	12	67	1,464
	2013	172,865	43,314	659	83	0	3,118	1,291
	2014	180,470	51,731	849	555	118	6,017	806
	2015	133,885	8,289	793	303	0	9,663	463
Boat	2006	260,217	128,173	2,203	2,651	663	18,286	11,984
	2007	221,692	71,166	638	2,145	849	29,808	8,617
	2008	261,825	173,285	2,594	1,895	1,662	13,799	8,637
	2009	217,193	115,601	854	1,206	689	15,361	3,985
	2010	293,884	107,928	1,973	2,591	958	26,143	6,467
	2011	196,848	23,725	434	2,800	3,008	24,859	4,747
	2012	257,762	19,443	317	4,659	3,624	48,777	12,192
	2013	209,530	9,793	4,356	3,071	2,962	33,121	5,132
	2014	182,583	2,744	5,237	6,277	4,175	24,297	4,206
	2015	187,078	0	655	3,039	2,418	25,193	7,093
Season	2006	536,753	316,708	2,895	2,955	663	18,634	14,718
	2007	473,604	287,603	1,748	2,456	883	30,299	11,159
	2008	546,380	317,429	4,447	2,289	1,660	15,979	10,950
	2009	542,995	263,542	1,599	1,713	689	17,727	6,907
	2010	525,005	201,914	2,603	2,975	958	30,855	8,222
	2011	366,571	56,796	1,098	3,112	3,008	29,618	5,902
	2012	464,933	93,849	1,195	4,681	3,636	48,844	13,656
	2013	382,395	53,107	5,015	3,154	2,962	36,239	6,423
	2014	363,053	54,475	6,086	6,832	4,293	30,314	5,012
	2015	320,963	8,289	1,448	3,342	2,418	34,856	7,556

Table 14. March fishing effort and harvest by non-charter anglers at selected sites in the Illinois portion of Lake Michigan, in 2006 - 2015. Estimates were rounded to the nearest whole number. Peds = Pedestrian, Lau'd = Launched boat anglers.

		Effort	Harvest					
Angler type	Year	(angler-hours)	Yellow perch	Brown trout	Rainbow trout	Lake trout	Coho salmon	Chinook salmon
Peds	2006	11,560	0	1,467	65	0	259	0
	2007	9,819	373	764	0	0	386	0
	2008	5,940	261	347	52	0	797	0
	2009	6,296	108	160	85	0	84	0
	2010	8,642	0	549	97	0	65	0
	2011	6,937	28	15	75	0	292	0
	2012	17,941	4,103	915	0	0	1,941	0
	2013	2,363	0	67	0	0	28	0
	2014	5,241	0	0	0	0	988	0
	2015	5,954	0	199	0	0	754	0
Lau'd	2006	3,199	4,456	478	0	0	182	0
	2007	4,199	10,165	382	9	0	98	0
	2008	3,117	1,024	81	0	0	0	0
	2009	10,109	19,214	10	0	0	37	0
	2010	10,907	16,928	451	0	206	113	0
	2011	1,144	0	72	0	0	909	0
	2012	8,059	4,780	912	41	21	1,283	0
	2013	1,486	1,135	0	0	0	19	0
	2014	1,167	0	73	15	0	381	0
	2015	1,730	0	654	0	0	541	0
March Totals	2006	14,759	4,456	1,945	65	0	441	0
	2007	14,018	10,538	1,146	9	0	484	0
	2008	9,057	1,285	428	52	0	797	0
	2009	16,405	19,322	170	85	0	121	0
	2010	19,549	16,928	1,000	97	206	178	0
	2011	8,081	28	87	75	0	1,201	0
	2012	26,000	8,883	1,827	41	21	3,224	0
	2013	3,849	1,135	67	0	0	47	0
	2014	6,408	0	73	15	0	1,369	0
	2015	7,684	0	853	0	0	1,295	0

Table 15. Minor species harvest by non-charter anglers in the Illinois portion of Lake Michigan, in 2006 - 2015. Estimates were rounded to the nearest whole number.

Year	Smallmouth bass	Largemouth bass	Rock bass	Bluegill sunfish	Pumpkinseed sunfish	Common carp	Freshwater drum	Round goby
2006	46	97	6,697	550	28	147	2,990	-
2007	252	49	10,650	269	20	154	1,965	-
2008	80	45	7,561	405	0	43	2,033	-
2009	76	0	3,934	298	0	240	1,482	-
2010	51	0	1,938	402	9	8	1,768	-
2011	0	4	575	309	0	238	2,946	-
2012	38	0	2,001	406	42	216	3,540	-
2013	68	20	804	546	0	208	6,205	-
2014	154	0	274	0	0	104	688	33,484
2015	0	0	284	76	0	121	2,786	18,803

Figure 2 (a). Salmonid harvest per unit effort, derived from the Illinois sport fishing surveys of Lake Michigan, 2006-2015

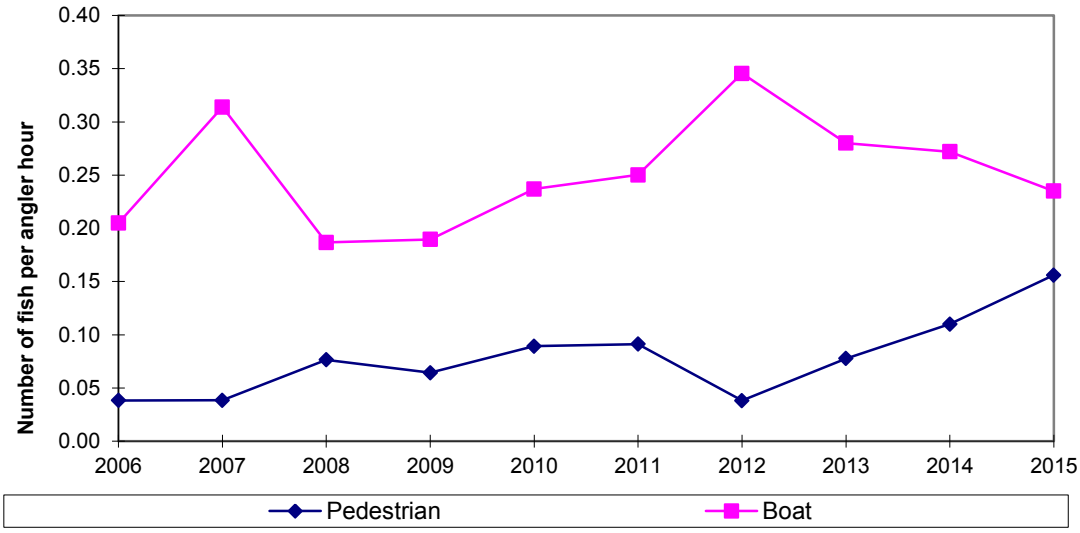


Figure 2 (b). Yellow perch harvest per unit effort, derived from Illinois sport fishing surveys of Lake Michigan, 2006-2015

Figure 3 (a). Directed angler effort for salmonids in the Illinois portion of Lake Michigan, 2006-2015

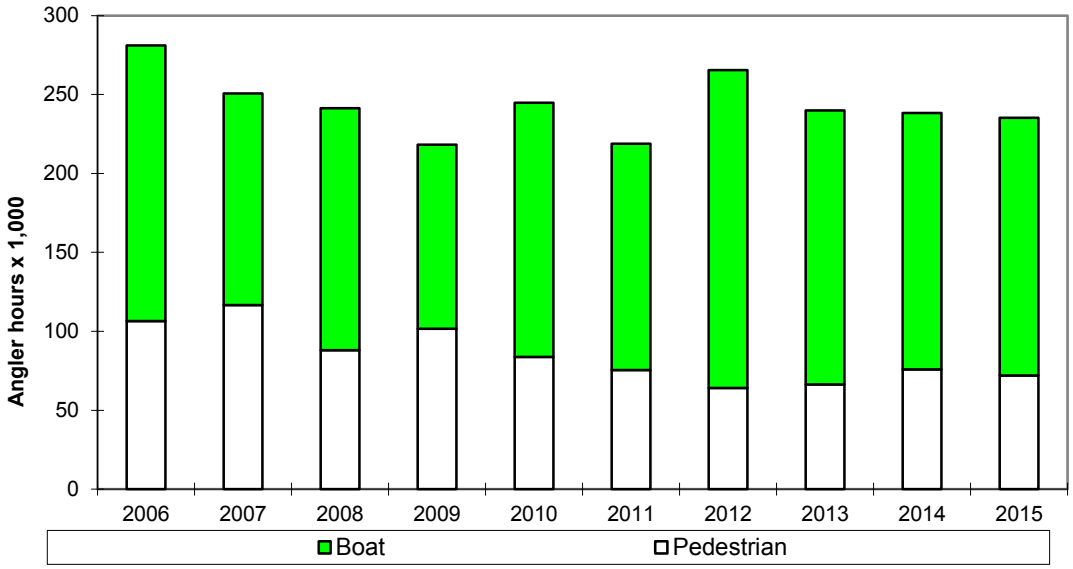


Figure 3 (b). Directed angler effort for yellow perch in the Illinois portion of Lake Michigan, 2006-2015

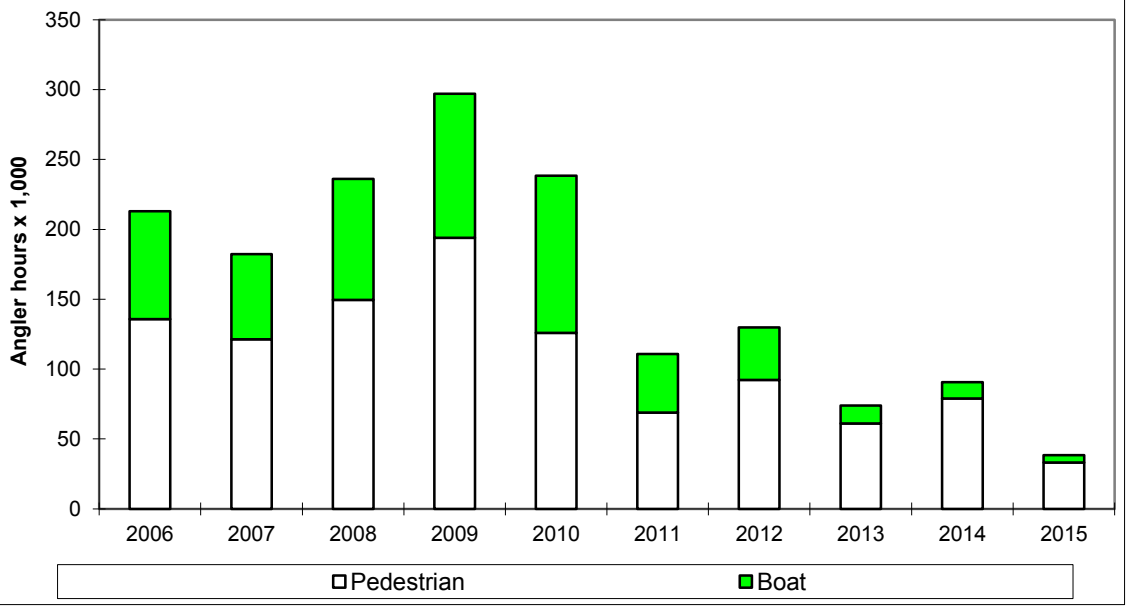


Figure 4. Total yellow perch non-charter sport harvest in the Illinois waters of Lake Michigan, 2006-2015

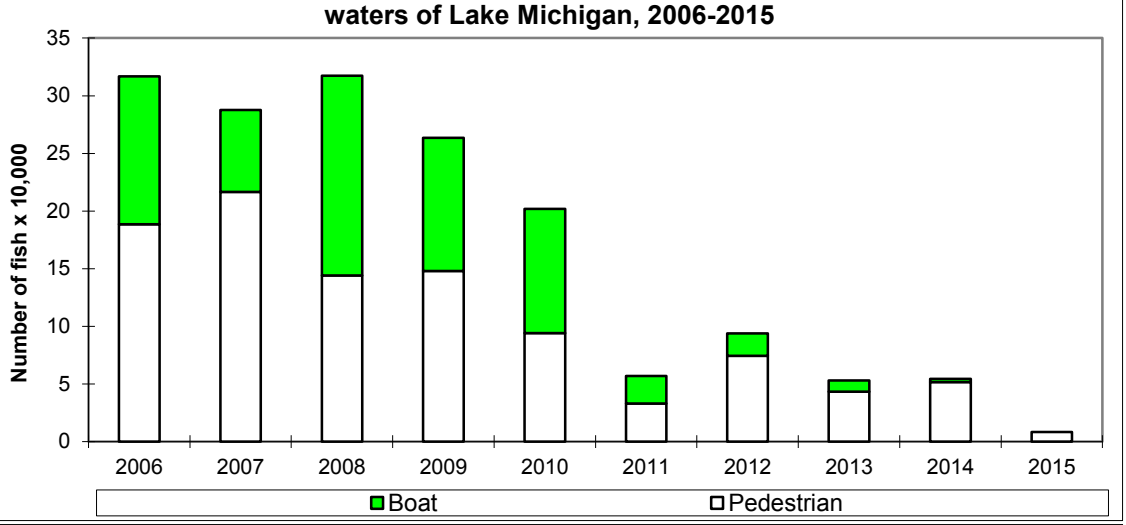


Figure 5. Average lengths of creeled yellow perch from the Illinois waters of Lake Michigan, 1986 - 2015

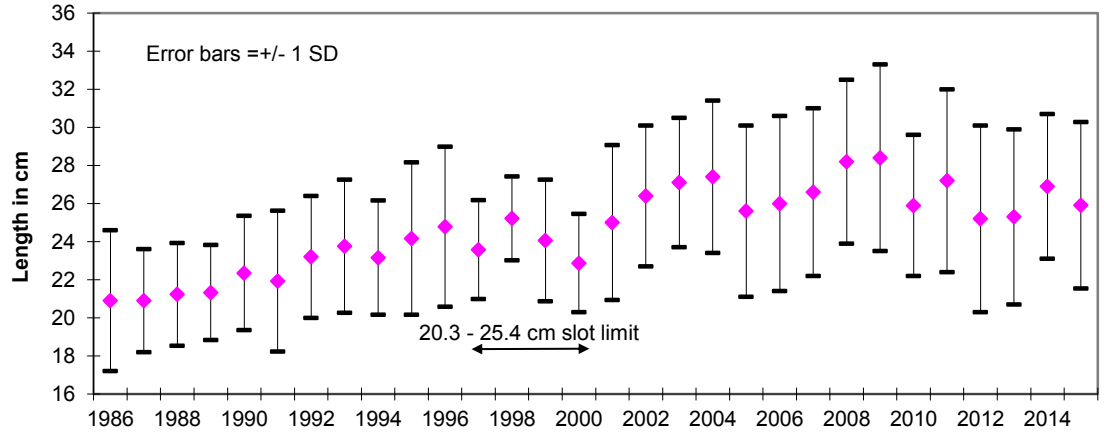


Figure 6. 2015 yellow perch sport harvest from the Illinois waters of Lake Michigan, per month

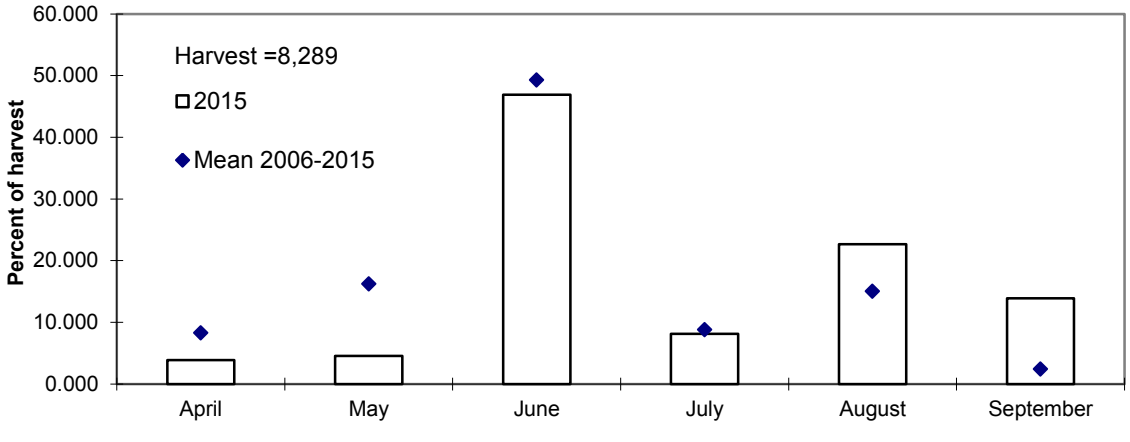


Figure 7. Total non-charter coho salmon sport harvest in the Illinois waters of Lake Michigan, 2006- 2015

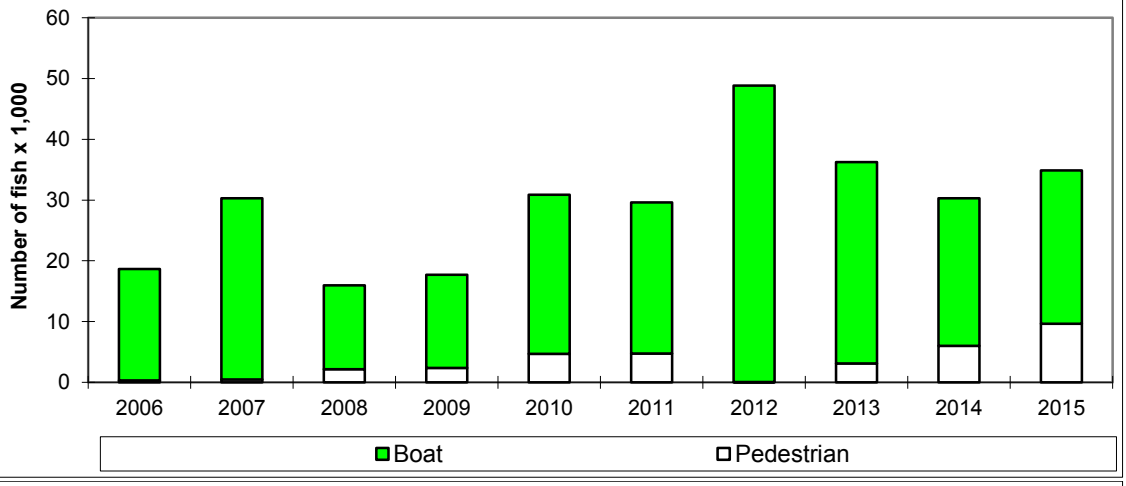


Figure 8. Average lengths of creeled coho salmon from the Illinois waters of Lake Michigan, 1986 - 2015

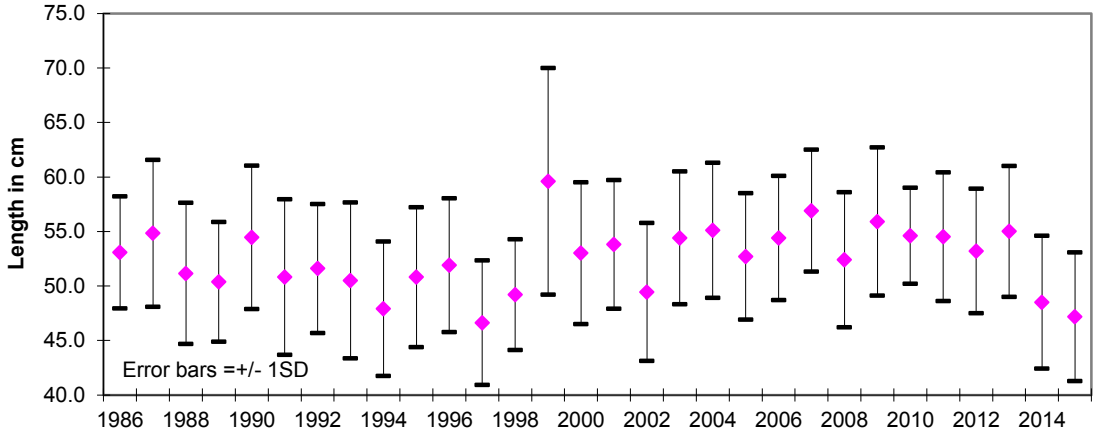


Figure 9. Total non-charter chinook salmon sport harvest in the Illinois waters of Lake Michigan, 2006-2015

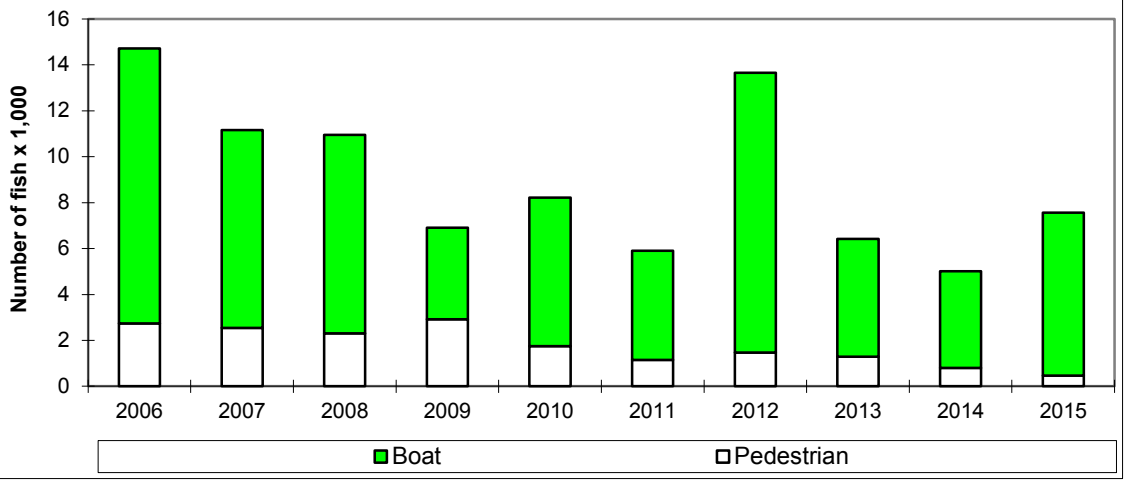


Figure 10. Average lengths of creeled chinook salmon from the Illinois waters of Lake Michigan, 1986 - 2015

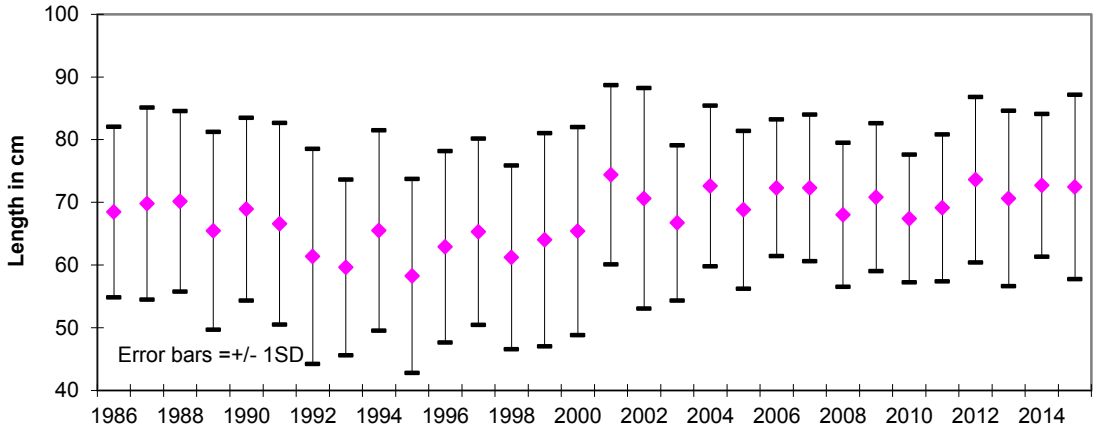


Figure 11 (a). 2015 Salmonid non-charter harvest and effort by pedestrians, per month

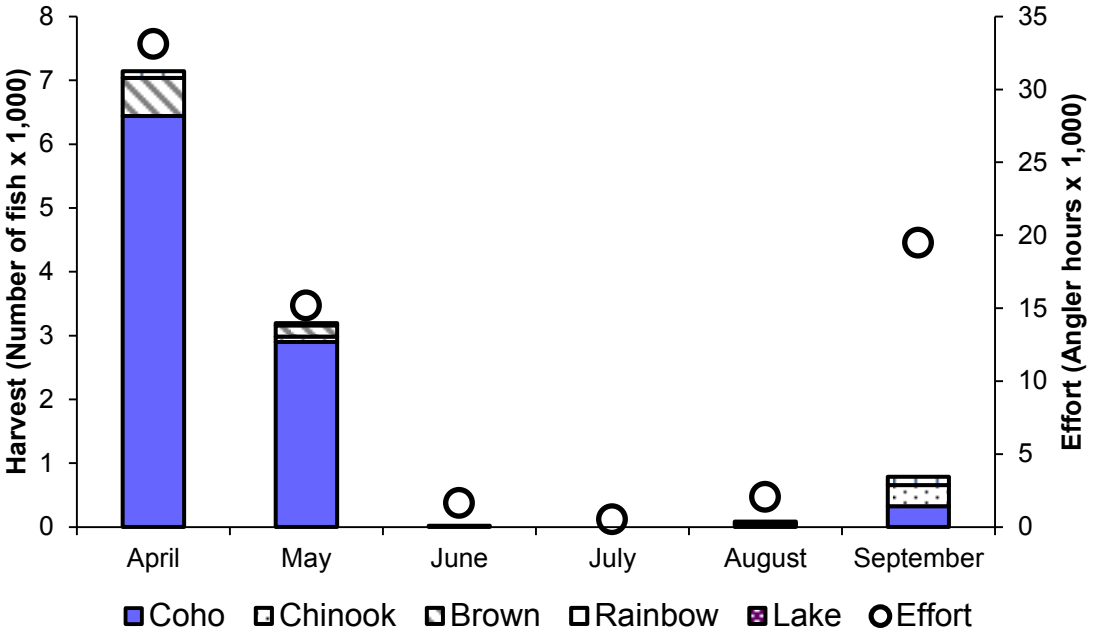


Figure 11 (b). 2015 Salmonid non-charter harvest and effort by boaters, per month

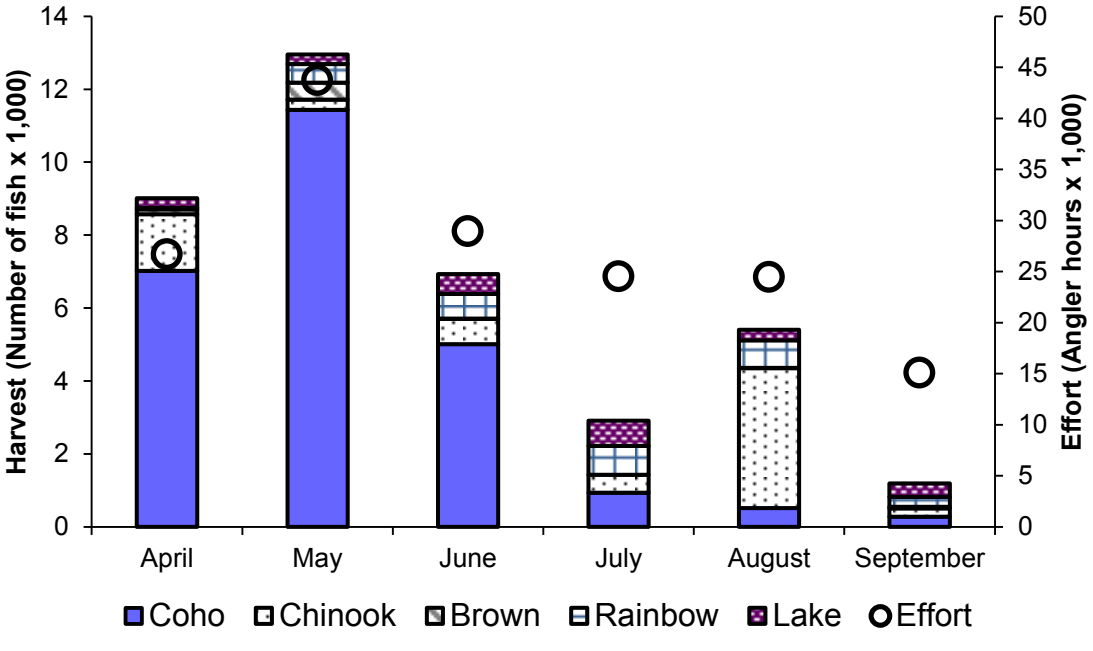
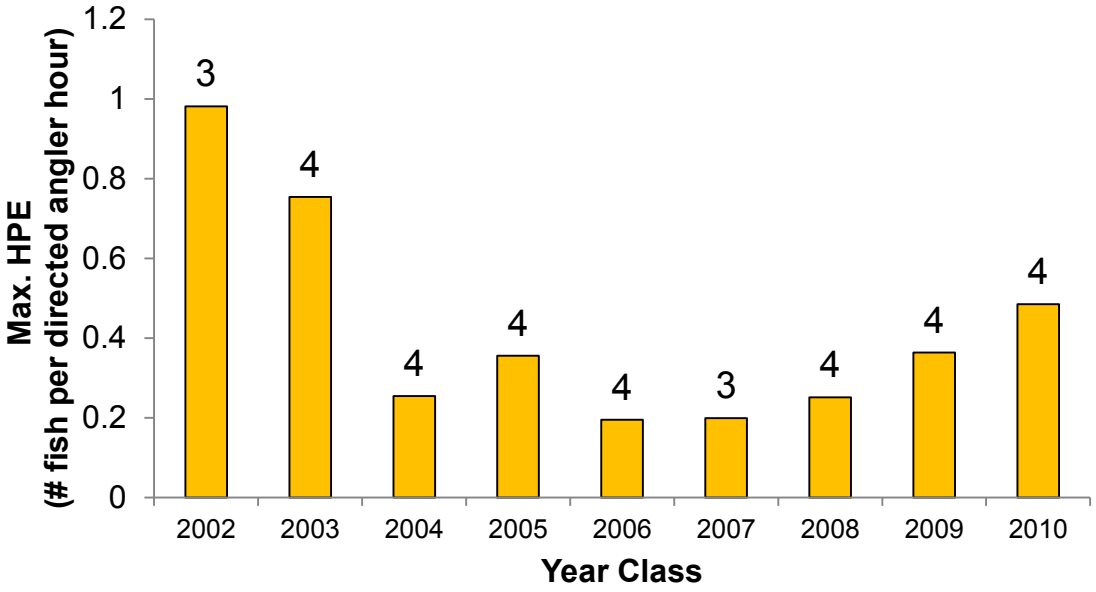


Figure 12. Maximum pedestrian yellow perch HPE for each year class, and age at which max. HPE occurred



APPENDIX A - COMPARISON OF THE CHARTER AND NON - CHARTER SALMONID BOAT FISHERY

The charter and non - charter boat salmonid fisheries were compared to evaluate whether the two groups target the same salmonid species (Tables A1 and A2). In general, composition of total harvest for both groups has been similar for the last ten years. Harvest-per-unit-effort (HPE) for both groups is presented in Figure A1; the charter fishery has generally exhibited higher success than the non - charter boat fishery (charter HPE approximately double non-charter HPE). The combined harvest of both charter and non - charter anglers (boats and pedestrians) for 2006 - 2015 is presented in Figure A2. These data represent only harvest and effort from April-September (early spring surveys are not included).

Table A1. Non-charter boat harvest composition (boats only) April – September 2006 - 2015.

	Effort	Percent of total harvest					
Year	(angler-hours)	Brown trout	Rainbow trout	Lake trout	Coho salmon	Chinook salmon	Total salmonids
2006	174,621	6.2	7.4	1.9	51.1	33.5	35,787
2007	133,974	1.5	5.1	2.0	70.9	20.5	42,057
2008	153,169	9.1	6.6	5.8	48.3	30.2	28,587
2009	116,514	3.9	5.5	3.1	69.5	18.0	22,095
2010	160,945	5.2	6.8	2.5	68.6	17.0	38,132
2011	143,331	1.2	7.8	8.4	69.3	13.2	35,848
2012	201,326	0.5	6.7	5.2	70.1	17.5	69,569
2013	173,695	9.0	6.3	6.1	68.1	10.6	48,642
2014	162,453	11.9	14.2	9.4	55.0	9.5	44,192
2015	163,424	1.7	7.9	6.3	65.6	18.5	38,398

Table A2. Charter boat harvest composition April – September 2006 - 2015.

	Effort						Percent of total harvest
Year	(angler-hours)	Brown trout	Rainbow trout	Lake trout	Coho salmon	Chinook salmon	Total salmonids
2006	99,698	1.2	5.5	2.5	54.0	36.7	51,753
2007	87,763	2.9	3.2	2.9	66.5	24.6	50,218
2008	91,756	2.9	5.2	4.6	59.4	28.0	41,499
2009	88,221	2.0	6.7	5.3	59.1	26.9	34,349
2010	94,406	1.1	13.9	6.0	53.1	26.0	43,883
2011	91,235	0.5	8.6	7.0	67.6	16.3	48,585
2012	96,818	1.0	6.0	10.8	58.1	24.2	50,425
2013	95,530	2.2	7.1	12.2	63.8	14.6	42,556
2014	94,976	1.2	10.0	19.2	60.2	9.4	40,902
2015	97,893	1.4	7.9	27.1	58.4	5.2	40,902

Figure A1. Comparsion of charter and non-charter boat salmonid harvest rates for the Illinois portion of Lake Michigan, 2006-2015

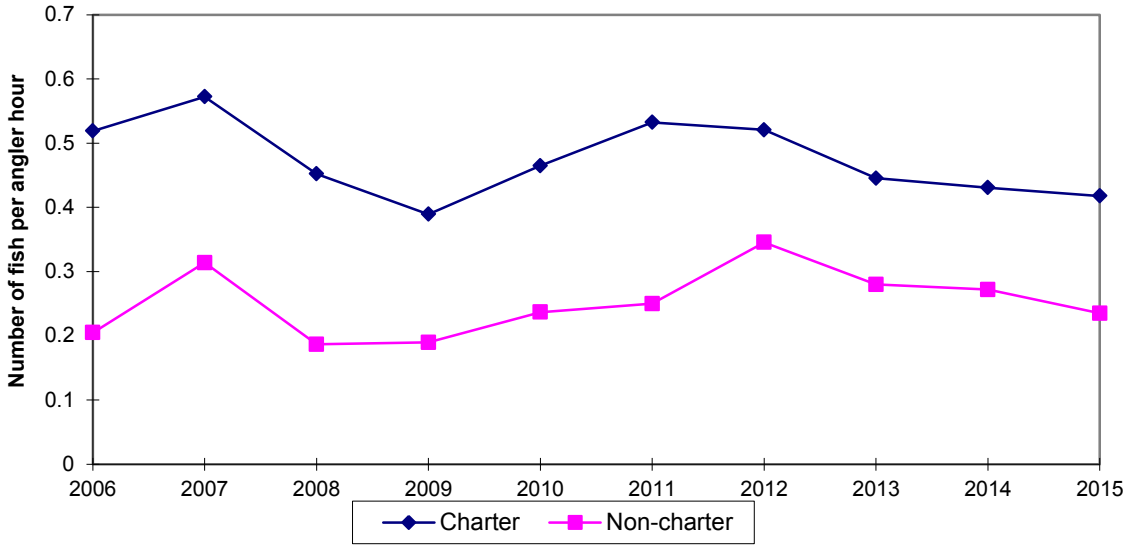
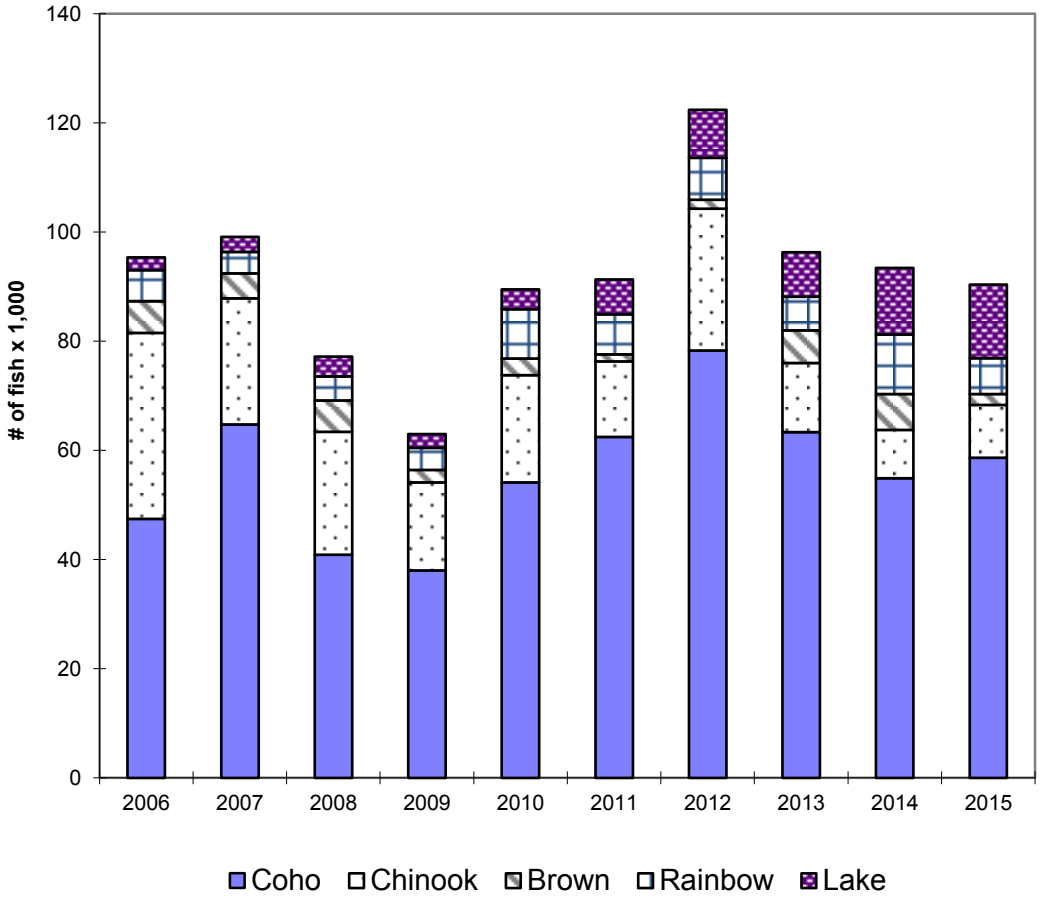


Figure A2. Illinois Lake Michigan sportfishing harvest (charter & regular combined) 2006 - 2015



APPENDIX B – WINTER YELLOW PERCH ANGLING EFFORT AND CATCH IN CHICAGO

INTRODUCTION

Previous surveys of recreational angling have shown a significant, but relatively small amount of angling effort in Chicago during fall and winter months, primarily targeted at yellow perch. Creel surveys during the October-February period (hereafter referred to as winter surveys) were conducted during the winters of 1986-'87, 1987-'88, 1988-'89, and 2006-'07. In these surveys, yellow perch harvest estimates ranged from 2,886 fish to 91,314 fish, and represented between 0.2% and 8.1% of the total annual yellow perch harvest estimates (INHS data).

Since the 2006-'07 winter survey, important changes have occurred in the Lake Michigan ecosystem, and harvest estimates for yellow perch during the typical survey months (March-September) have declined substantially. In addition, access to some lakefront locations in the south side of Chicago has improved since 2007; creel clerk observations and online fishing reports suggest angler use has dramatically increased in the winter months at some of these sites (most notably at the 85th Street slip, which adjoins newly-opened Steelworkers Park). Furthermore, previous winter surveys indicated fishing effort varied substantially based on weather (i.e., ice cover in the harbors). Thus, a survey of winter angling was needed to assess the impact of the ecosystem and access changes on the Lake Michigan fishery in Chicago, and to further evaluate the impact of meteorological variables on fishing effort. Our objective was to produce results comparable to those from previous winter surveys; therefore, we implemented a winter survey of angling in Chicago with a similar design to the survey conducted in 2006-'07.

METHODS

We used methods similar to the standard Lake Michigan shoreline creel survey (Roswell and Czesny 2015). In this case, however, clerks moved along on a route, with no set time to spend at each site. Unlike the most recent winters survey in 2006-'07 (in which only angling parties targeting yellow perch were interviewed), all angling parties encountered were surveyed, until the threshold of ten parties targeting perch was reached (or all anglers at the site were interviewed), after which the clerk would move to the next site. If no anglers were fishing at a site, the clerk would record a count of zero anglers and proceed to the next site.

The clerk would always start at Navy Pier at 7:00 AM (because of the parking situation). The clerk would then go to the next site (either north or south depending on the schedule) and continue until all of the sites were visited. The clerk would always end at the launch ramp at Calumet Park (and stay there for an hour if there were boat trailers in the lot). A complete list of sites can be found in table B1.

All sites were visited on scheduled dates. Dates were selected based on a stratified random sample, in which weekends vs. weekdays represented the two strata. One random date was selected from each weekend (Saturday or Sunday), and one random weekday (Monday-Friday) was selected every other week. Surveys were cancelled (without rescheduling)

on 6 dates due to inclement weather (i.e., heavy snow or subzero cold). Another survey date was cancelled due to personnel shortages. Data were summarized using strata means for each month and site.

Table B1. Sites visited in Chicago for the winter survey.

Site	Order visited (North schedule)	Order Visited (South schedule)	Angler Type
Navy Pier	1	1	Pedestrian
Diversey Harbor	2	3	Pedestrian
Belmont Harbor	3	4	Pedestrian
Montrose Harbor	4	5	Pedestrian
Burnham Harbor	5	2	Pedestrian
Jackson Harbor	6	6	Pedestrian
85th Street Slip	7	7	Pedestrian
Calumet Ramp	8	8	Launched Boat

RESULTS

On 25 dates during winter of 2014-'15, creel clerks conducted 184 interviews of pedestrian anglers; zero boat anglers were interviewed (only one boat angling party, which declined an interview, was encountered). Clerks measured 80 yellow perch harvested by anglers.

An estimated 11,610 angler-hours were directed at yellow perch angling, resulting in an estimated harvest of 6,431 yellow perch. An estimated 5,991 additional yellow perch were released by anglers. January accounted for 57.6% of total yellow perch harvest, and most perch were harvested at Diversey (57.2%) or 85th Street (37.0%; Table B2). Yellow perch harvested in the winter of 2014-'15 were substantially smaller than perch harvested in spring and summer of 2014 (Figure B1); the mean length of yellow perch harvested in winter was 21.7 cm, and the mean weight was 110 grams.

Table B2. Estimated monthly total angler effort directed at yellow perch, yellow perch harvest, and number of yellow perch released for each site visited in the winter creel survey 2014-2015.

Month	Location	Yellow Perch Effort (angler hours)	Yellow Perch Harvested	Yellow Perch Released
October	85th Street	171	0	0
	Belmont Harbor	0	0	0
	Diversey Harbor	0	0	0
	Jackson Harbor	0	0	0
	Montrose Harbor	67	0	0
	Navy Pier	0	0	0
	Burnham Harbor	0	0	0
	Calumet Ramp	0	0	0
November	85th Street	1,703	538	297
	Belmont Harbor	0	0	0
	Diversey	0	0	0
	Jackson Harbor	0	0	0
	Montrose Harbor	0	0	0
	Navy Pier	592	271	1,437
	Burnham Harbor	0	0	0
	Calumet Ramp	0	0	0
December	85th Street	541	420	891
	Belmont Harbor	0	0	0
	Diversey Harbor	1,839	1,414	701
	Jackson Harbor	0	0	0
	Montrose Harbor	41	0	0
	Navy Pier	1,307	59	0
	Burnham Harbor	0	0	0
	Calumet Ramp	0	0	0
January	85th Street	2,629	1,423	1,059
	Belmont Harbor	0	0	0
	Diversey Harbor	2,190	2,239	1,482
	Jackson Harbor	0	0	0
	Montrose Harbor	92	0	0
	Navy Pier	283	43	0
	Burnham Harbor	0	0	0
	Calumet Ramp	0	0	0
February	85th Street	0	0	0
	Belmont Harbor	0	0	0
	Diversey Harbor	155	24	124
	Jackson Harbor	0	0	0
	Montrose Harbor	0	0	0
	Navy Pier	0	0	0
	Burnham Harbor	0	0	0
	Calumet Ramp	0	0	0

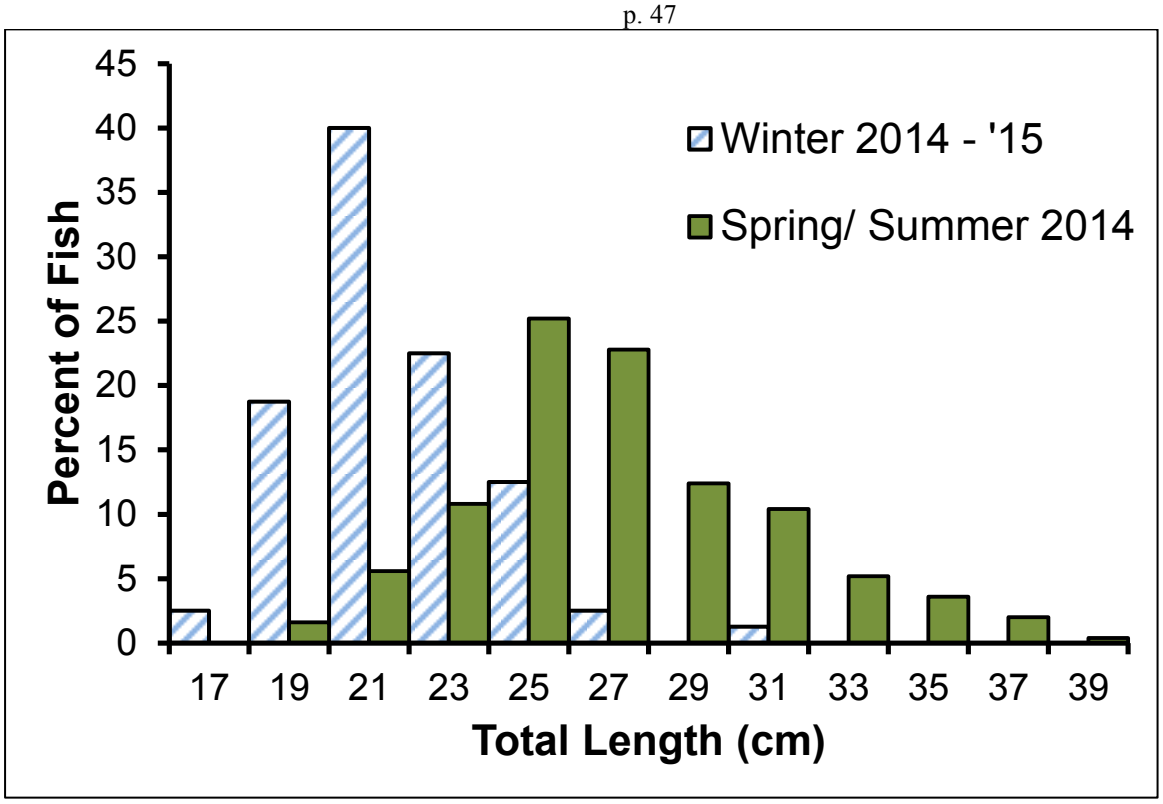


Figure B1. Length frequency distribution of yellow perch harvested in winter (October 2014-February 2015, blue/ white striped bars) and spring/ summer (April-September 2014, solid green bars). Lengths are grouped into 2 cm bins (labeled by bin midpoint).

DISCUSSION

During the winter of 2014-'15, yellow perch fishing constituted a small but important component of the Lake Michigan recreational fishery in Illinois. The 11,610 angler-hours spent by winter perch anglers (all pedestrians) represents 6.4% of total pedestrian angler-hours and 3.2% of total combined (pedestrian and boater) angler-hours fished in Illinois waters during April-September 2014. The estimated harvest of 6,431 yellow perch during winter represents 11.8% of the April-September 2014 harvest estimate, and 10.6% of the total annual harvest for the period of March 2014-February 2015.

Some notable differences between the summer and winter yellow perch fishery segments were observed. One difference was the composition of the harvest. In spring and summer, perch across a broad range of sizes were harvested, while in winter the harvest consisted primarily of small fish. In fact, 83.8% of perch harvested in the winter survey were smaller than 24 cm in total length, while 82.0% of spring and summer perch were 24 cm or larger. The winter mean weight of harvested fish was 58.9% smaller than harvested yellow perch during spring and summer of 2014 (mean weight of 267 g); the winter mean length was 19.3% smaller than for spring and summer fish (mean length of 26.9 cm).

Another important difference between the typical (March – September) survey period and winter of 2014-'15 was the spatial distribution of anglers. During spring and summer, Montrose Harbor (and vicinity) accounts for the majority of pedestrian yellow perch fishing effort. However, results from this winter survey suggest Montrose harbor represented less than 10% of total perch-directed fishing effort by pedestrians. Instead, the primary areas utilized by yellow perch anglers in winter were the 85th street slip, Diversey Harbor, and Navy Pier. Combined, these areas account for less than 10% of pedestrian anglers observed during helicopter flights (Table 2 in the main body of this report), a pattern corroborated by frequent observations by creel clerks. But these sites accounted for more than 98% of perch-directed angler-hours for pedestrians fishing in the winter of 2014-'15. In addition to seasonal movement of yellow perch, the shift in spatial distribution of anglers may be attributable to several factors such as access changes, amenities (e.g., bathrooms), and weather-related factors (e.g., ice).

Weather is a major factor that likely has a large influence not only on locations anglers use for fishing, but also on the time spent fishing and fishing success of anglers. For example, the presence and thickness of ice (driven by cold temperatures) in harbor areas can play a large role in the ease of fishing. The presence of ice forces anglers at some locations to break holes in the ice to fish, which may make sites with open water more appealing. However, very thick ice may allow anglers to walk on the ice and drill holes to find fish, which may attract anglers interested in ice fishing at locations that freeze early (e.g., areas lacking wave action or current) following a long period of cold temperatures. High winds may drive anglers to seek sheltered areas, and prolonged periods of high winds can increase turbidity (usually anglers associate turbidity with poor catch rates, C. Roswell personal observations) through wave action. Large snow events can restrict access to some sites. All winters in Chicago have periods of cold temperatures, high winds, and snow; however, there can be considerable variation in the frequency, magnitude, and duration of these events from one winter to the next. The winter of 2014-'15 was characterized by colder than average temperatures, and at least one large snow event (in early February) caused restricted access to many surveyed sites for a week or longer. Ice cover this winter may have driven fishing effort down at several locations, including Montrose harbor, which accounted for the majority of the angler effort and perch harvest in the winter of 2006-'07. Cold temperatures and ice likely contributed to our lack of boat angler observations. However, a significant number of anglers were observed ice fishing at several sites in 2014-'15, especially Diversey Harbor.

Other types of fishing

Yellow perch angling constituted the primary component of recreational angling during the October – February period as a whole, and 97.8% of anglers contacted during the months of November – February were targeting perch. The vast majority of angling activity not directed a yellow perch was comprised of anglers targeting salmonines, especially in October, when 81.9% of anglers interviewed were targeting salmon and/ or trout. A small number (1.5% of interviewed anglers) seeking salmonines were also encountered in November and December, and in October, 10.8% of encountered anglers were targeting other species or "anything that bites." Our estimates reported here only used interviews with angling parties targeting perch. However, all data from other types of angling are stored in an INHS database for future comparisons, including comparisons with the winter of 2015-'16, during which another winter creel survey took place.

Limitations

Some uncertainty surrounds our estimates, especially due to a low level of survey effort. It is possible that some fishing activity was missed (i.e., some boat fishing for perch likely occurred, but was not picked up in our survey); however, this would likely represent only a small portion of the overall fishery. Furthermore, with fewer survey dates, there is a higher likelihood of one date (with a very high catch rate, for example) being highly influential in our estimates of monthly means. However, examination of our data suggests this was not the case; while variable, dates with extremely high catch rates (i.e., outliers) were not driving monthly means.

An important assumption is that our survey data are representative of the entire day, despite a "semi-random" sampling order (e.g., north or south directions following Navy Pier were assigned randomly for each sampling date), and surveys always began at 7:00 am (i.e., late afternoon/ evening fishing activity was not sampled). However, our data suggest catch rates for yellow perch during the winter period, while variable through the day, are not consistently higher at one time of day than any other. On the other hand, fishing effort likely was not constant throughout the day, especially at Navy Pier, where parking rates increase substantially after 10:00 am. Typically, pedestrian fishing effort in Chicago tends to be highest in the morning (INHS, unpublished data), likely driven in part by anglers avoiding peak traffic periods. Thus, our survey may have slightly overestimated fishing effort, and in turn, total catch. However, this survey design is consistent with previous years' winter surveys, thereby facilitating comparisons across years. Moreover, the long-running April-September creel survey also primarily gathers data during the morning hours. We contend that a) our estimates likely do not depart substantially from true effort and harvest, and b) comparability with previous winters and the typical spring/ summer survey is an important characteristic of our dataset; therefore, these estimates are valuable for understanding general patterns, but readers should not focus on specific values without context.

We attempted to account for temporal variability in fishing locations by covering a wide range of sites that we knew were used by anglers, and periodically checked other locations to account for seasonal changes in angler use. To ensure all sites were visited in a timely manner (thus, maintaining comparable times for sampling), we dropped locations where anglers were consistently absent over several weeks. This caused us to drop Diversey during November, before resuming surveys there following observations of angler use of that site. Therefore, while Diversey estimates for catch and effort during November are listed as zeros in Table B2, a negligible amount of fishing activity may have been missed during November.

Finally, another potential limitation was problems with access for creel clerks. In some cases, when access was difficult for creel clerks, it was also likely difficult for anglers to visit locations (e.g., following heavy snowfall). However, creel clerks were advised to avoid trespassing or walking on ice. This made interviewing anglers fishing on the ice (especially at Montrose and Diversey harbors) or on private land (i.e., the private portion at 85th street) difficult. Typically, creel clerks could obtain a few interviews by waiting for anglers to finish their trip, or by talking to anglers in or near accessible portions of impacted sites. Thus, estimates of catch rates were still collected, but these estimates may not have been as precise as would be the case if all anglers were interviewed. Limited access usually did not interfere with angler counts used to estimate effort.

Conclusions

Despite some caveats, our survey produced meaningful estimates of catch of yellow perch and perch-directed angler effort during the winter of 2014-'15. The majority of angler effort in Chicago during winter months was directed at yellow perch. Winter perch harvest was a significant portion of the fishery, representing slightly more than 10% of total annual perch harvest (March 2014- February 2015). Yellow perch harvested in the winter tended to be smaller than typical perch harvested during April – September. The perch harvest in this winter represented a larger proportion of total annual perch harvest than any of the four previous winter surveys conducted since 1985. Another winter creel survey was completed during October 2015-February 2016, which will provide useful information on inter-annual variability in the winter fishery.